

## The Nervous System

**Choose all of the correct answers, and be prepared to explain your choice :**

### 1. Electrical transmission in the nervous system was first observed in ...

- a) 1492
- b) 1791
- c) 1938
- d) squid tentacles
- e) frog legs

### 2. Sodium ions enter the nerve cell ...

- a) thanks to the  $\text{Na}^+\text{-K}^+$  pump
- b) through ligand-gated ion channels
- c) through voltage-gated ion channels
- d) at +50mV
- e) when  $\text{K}^+$  ions exit

### 3. Nerve fibers become positively charged ...

- a) at rest
- b) when  $\text{K}^+$  ions exit from the cell
- c) when  $\text{Na}^+$  ions are added to  $\text{K}^+$  inside
- d) thanks to the  $\text{Na}^+\text{-K}^+$  pump
- e) during the action potential

### 4. Curare ...

- a) hydrolyzes acetylcholine
- b) blocks the acetylcholine receptor
- c) inhibits cholinesterase
- d) allowed scientists to discover the synapse
- e) is an antagonist for noradrenaline

### 5. Nerves in the parasympathetic system ...

- a) release acetylcholine
- b) release noradrenaline
- c) target  $\beta$ -adrenergic receptors
- d) promote a "fight-or-flight" response
- e) promote a "rest-and-digest" response

### 6. Most of the cranial nerves ...

- a) originate in the brainstem
- b) contain motor and sensory fibers
- c) conduct signals from the brain to the limbs
- d) do not leave the region of the skull
- e) contain sensory fibers only

### 7. All of the spinal nerves ...

- a) form plexuses
- b) contain motor and sensory fibers
- c) have anterior and posterior branches
- d) are numbered from 1 to 31
- e) have a dorsal motor root

### 8. The "blood-brain barrier"...

- a) surrounds the brain to protect it from pathogens
- b) prevents toxins from entering the brain
- c) prevents alcohol from entering the brain
- d) describes the specific structure of brain capillaries
- e) contains cerebrospinal fluid (CSF)

### 9. The "corpus callosum" ...

- a) connects the two hemispheres of the cerebral cortex
- b) is part of the brainstem
- c) was published by Andreas Vesalius in 1543
- d) allows communication between different areas of the brain
- e) is a Latin name meaning "little brain"

### 10. Broca's area ...

- a) receives information from the optic nerve
- b) is located in the right cerebral hemisphere
- c) is located in the left cerebral hemisphere
- d) controls voluntary movements
- e) is often referred to as the "speech center"

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

1. The system of cells, tissues, and organs that regulates the body's responses to internal and external stimuli. It consists of the brain, spinal cord, nerves, ganglia, and parts of the receptor and effector organs : \_\_\_\_\_
2. The impulse-conducting cells that constitute the brain, spinal column, and nerves, consisting of a nucleated cell body with one or more dendrites and a single axon. Also called nerve cell : \_\_\_\_\_
3. The portion of a nerve cell that contains the nucleus but does not incorporate the dendrites or axon. Also called soma : \_\_\_\_\_
4. An outgrowth (projection) of tissue; a projecting part : \_\_\_\_\_
5. Having little length; not long : \_\_\_\_\_
6. With no restriction or obstruction : \_\_\_\_\_
7. To come out as a subdivision; develop or diverge from : \_\_\_\_\_
8. A slender (long and thin), elongated, threadlike object or structure (threadlike = resembling a filament). A strand of nerve tissue : \_\_\_\_\_
9. A branched protoplasmic extension of a nerve cell that conducts impulses from adjacent cells inward toward the cell body. : \_\_\_\_\_
10. One in number. Individual and distinct. Consisting of one part : \_\_\_\_\_
11. The usually long process of a nerve fiber that generally conducts impulses away from the body of the nerve cell : \_\_\_\_\_
12. To send out from a center; emit : \_\_\_\_\_

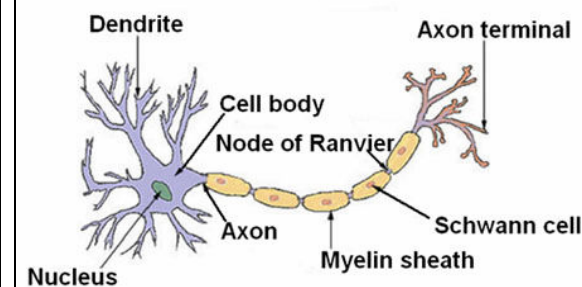
13. Over or throughout the length of; progressively : \_\_\_\_\_
14. The direction of continuing movement. A route or path : \_\_\_\_\_
15. To transport. To serve as a medium of transmission; transmit. To communicate : \_\_\_\_\_
16. The electrochemical transmission of a signal along a nerve fiber that produces an excitatory or inhibitory response at a target tissue, such as a muscle or another nerve : \_\_\_\_\_
17. Most important; principal; chief : \_\_\_\_\_
18. Acting as a medium for transmission : \_\_\_\_\_
19. In a different direction. Toward another place : \_\_\_\_\_
20. To show variation. To undergo (pass through) changes in certain attributes or qualities : \_\_\_\_\_
21. The measurement along the greatest dimension. Extent or distance from beginning to end : \_\_\_\_\_
22. A neuron that conveys impulses from the central nervous system to a muscle, gland, or other effector tissue : \_\_\_\_\_
23. To extend over or cover a distance. To extend, stretch, or reach in a certain direction or to a particular point : \_\_\_\_\_
24. The thick, whitish cord of nerve tissue that extends from the medulla oblongata down through the spinal column and from which the spinal nerves branch off to various parts of the body : \_\_\_\_\_
25. A tissue composed of fibers capable of contracting to effect bodily movement. A contractile organ consisting of a special bundle of muscle tissue, which moves a particular bone, part, or substance of the body : \_\_\_\_\_
26. The terminal part of the leg upon which an individual stands : \_\_\_\_\_
27. Linking two neurons in a neuronal pathway : \_\_\_\_\_
28. A connecting element; connection : \_\_\_\_\_
29. To perceive as being different or distinct. To perceive distinctly; discern : \_\_\_\_\_

## Neurons<sup>1</sup>

The basic unit of the nervous system is the neuron, or nerve cell. It\* consists of a cell body and its\* processes. Each neuron has two types of process : a number of short, freely branching fibres called dendrites, and a single process called the axon, which may or may not give off branches along its\* course. The dendrites convey impulses to the cell body; the axon, which is the main conducting fibre, conveys impulses away from the cell body. The axon varies in length in different kinds of neuron. In a motor neuron it\* can be very long,

running, for example, from a cell body in the spinal cord to a muscle in the foot. Axons of the internuncial neurons, which\* provide links between other neurons, are often short and difficult to distinguish from the dendrites.

## Structure of a Typical Neuron



The basic morphology of neurons consists of a cell body (a.k.a. soma) and a long thin axon which is covered by the myelin sheath. At the nodes of Ranvier (gaps between segments of myelin) the axonal membrane is uninsulated and therefore capable of generating electrical activity. Around the cell body is a branching dendritic tree that receives signals from other neurons. The end of the axon has branching terminals (axon terminals) that release neurotransmitters into a gap called the synaptic cleft between the terminals and the dendrites of the next neuron.

## What do the following words refer to ?

- a. "It consists of a cell body and..." → "It" refers to ...
- b. "and its processes" → "Its" refers to ...
- c. "along its course" → "Its" refers to ...
- d. "In a motor neuron it can be very long" → "It" refers to ...
- e. "which provide links" → "Which" refers to ...

## True or False ? (Be ready to explain and discuss).

- i. Axons can measure up to 1m in length.
- ii. Axons transmit signals to muscle cells, and dendrites transmit signals to other nerve cells.
- iii. Axons are insulated with myelin to accelerate the transmission of impulses.

Questions : (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.

## WHAT – HOW – HOW LONG

1. The components of a neuron. → ...

<sup>1</sup> Adapted from : *English in Basic Medical Science*, Oxford University Press

consists of – and two – several – and – single

*A neuron...*

2. **The features *and function* of dendrites. *The difference(s)* between dendrites and axons. → ...**

and freely – that convey – toward – whereas – single – that conduct – away – i.e. towards –  
e.g. – or

*Dendrites are...*

3. ***The potential length* of axons. → ...**

and can be – or very – can – as long – for example in – which – between – and – whereas in  
– no longer

*Axons vary in...*

4. **Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.**

Fundamentals of neuronal signaling : Action Potential

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

30. A person having expert knowledge of one or more sciences, especially a natural or physical science. : \_\_\_\_\_
31. A localized change in electrical potential, from about -70 mV to +30 mV and back again, that occurs across a nerve fibre during transmission of a nerve impulse : \_\_\_\_\_
32. The semipermeable membrane that encloses the cytoplasm of a cell. : \_\_\_\_\_
33. The property of having pores or openings that permit liquids or gases to pass through : \_\_\_\_\_
34. In a way not specified, understood, or known. : \_\_\_\_\_
35. A method, a course of action, or an instrument by which an act can be accomplished or an end achieved. : \_\_\_\_\_
36. Present and ready for use; accessible : \_\_\_\_\_
37. To comprehend completely or correctly; to become conscious or aware of (something) : \_\_\_\_\_
38. To extend, stretch, or reach in a certain direction or to a particular point : \_\_\_\_\_
39. Various marine cephalopod mollusks of the genus *Loligo* and related genera, having a usually elongated body, ten arms surrounding the mouth, a vestigial internal shell, and a pair of triangular or rounded fins. : \_\_\_\_\_
40. A conductor through which an electric current enters or leaves a substance electrical characteristics are being measured, used, or manipulated. : \_\_\_\_\_
41. At an earlier time, in the past, before : \_\_\_\_\_
42. 1. With a positive electrical charge 2. Definitely, surely, with certainty : \_\_\_\_\_
43. A measure of a material's ability to conduct electric charge; the reciprocal of the resistance. : \_\_\_\_\_
44. An atom or a group of atoms that has acquired a net electric charge by gaining or losing one or more electrons. : \_\_\_\_\_
45. 1. To shoot or pass over or beyond. 2. To go beyond; exceed. : \_\_\_\_\_
46. The potential difference between the two sides of the membrane of a nerve cell when the cell is not conducting an impulse : \_\_\_\_\_
47. 1. The act, process, or an instance of discovering (something) 2. A person, place, or thing that has been discovered : \_\_\_\_\_
48. To cause to happen, occur or exist : \_\_\_\_\_
49. Directed or moving toward the interior : \_\_\_\_\_
50. Symbol Na A soft, light, extremely malleable silver-white metallic element that reacts explosively with water, is naturally abundant in combined forms, especially in common salt. At. number 11; at. weight 22.99 : \_\_\_\_\_

51. Located on, or moving toward the outside or exterior; outer : \_\_\_\_\_
52. Symbol K A soft, silver-white, highly or explosively reactive metallic element that occurs in nature only in compounds. At. number 19; at. weight 39.1 : \_\_\_\_\_
53. The coming or arrival, especially of something extremely important : \_\_\_\_\_
54. A class of microscopes that use electrons rather than visible light to produce magnified images, especially of objects having dimensions smaller than the wavelengths of visible light, with linear magnification approaching or exceeding a million ( $10^6$ ) : \_\_\_\_\_
55. The technique of representing the real world by a computer program. The use of computers to replicate a mechanical or biologic function. : \_\_\_\_\_
56. A threadlike process of a neuron, especially the prolonged axon that conducts nerve impulses : \_\_\_\_\_
57. To keep in an existing state; preserve. To support. To keep in existence; sustain : \_\_\_\_\_
58. The condition of a physical system with regard to phase, form, composition, or structure : \_\_\_\_\_
59. Resistance to change. A condition of equilibrium : \_\_\_\_\_
60. The amount of a specified substance in a unit amount of another substance. The relative content of a component (as dissolved or dispersed material) of a solution, mixture, or dispersion that may be expressed in percentage by weight or by volume, in parts per million, or in grams per liter : \_\_\_\_\_
61. A covering or coating for an inside surface : \_\_\_\_\_
62. Relation in degree or number between two similar things : \_\_\_\_\_
63. 1. In this manner 2. Therefore; consequently (for this reason) : \_\_\_\_\_
64. Inactive : \_\_\_\_\_
65. Energized. Carrying or containing a positive or negative electromagnetic force or potential : \_\_\_\_\_
66. A wave of physical and chemical excitation along a nerve fiber in response to a stimulus, accompanied by a transient change in electric potential in the membrane of the fiber : \_\_\_\_\_
67. A disturbance or variation that transfers energy progressively from point to point in a medium. A periodic motion consisting of a series of many oscillations that propagate through a medium, as in the propagation of sound or light : the medium does not travel but only vibrates. : \_\_\_\_\_
68. Loss of the difference in charge between the inside and outside of the plasma membrane of a muscle or nerve cell due to a change in permeability and migration of sodium ions to the interior : \_\_\_\_\_
69. Absence or lack of equilibrium : \_\_\_\_\_
70. To set free from restraint; liberate : \_\_\_\_\_
71. Nearest in space or position; adjacent. Immediately following; immediately after : \_\_\_\_\_

72. One of the constituent parts into which a body, entity etc. is divided or marked off by natural boundaries : \_\_\_\_\_
73. And similarly; and continuing in a like manner : \_\_\_\_\_
74. The final point. The ultimate extremity of something that has length : \_\_\_\_\_

The role of electricity in the nervous systems of animals was first observed in dissected frogs in 1791 by the Italian anatomist Luigi Galvani, who suggested that animals used electrical signals in their nervous system. This was established in the mid-1800s by the Franco-German scientist Émil du Bois-Reymond who discovered the "**action potential**", i.e. the change in the electrical potential of the nerve cell. However, it was not until the early years of the 20th century that anyone tried to suggest a mechanism for how these signals could be generated. Between 1902-12, the German physiologist Julius Bernstein was able to determine that the cell membrane momentarily became much more positive than normal. He advanced the idea that the electrical signal resulted from a change in the permeability of the membrane which somehow allowed ions to pass through freely when the cell was excited. Bernstein's hypothesis was generally accepted, although there was no means available at the time to test it\* experimentally.

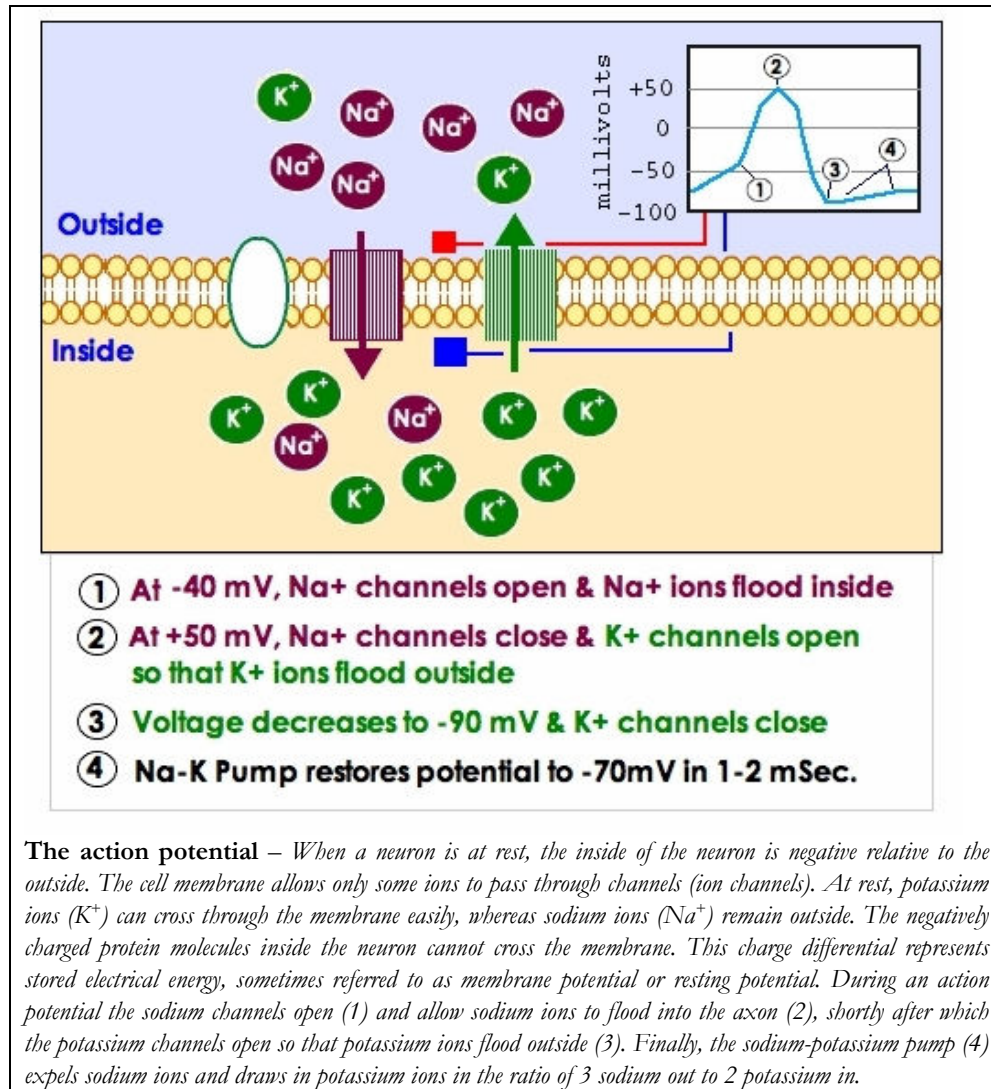
In 1936, the British anatomist J.Z. Young first realized that the large tubular structure running down the body of the squid was not a blood vessel, but a giant axon. The large diameter of the axon (0.5-1 mm) provided a great experimental advantage as it\* allowed scientists to insert electrodes inside the axon, which\* previously\* was impossible. Around 1938 American biophysicists Kenneth S. Cole and Howard J. Curtis obtained the first measurements of nerve cells during the conduction of an action potential which\* positively indicated, for the first time, that an increased conductance or permeability to ions characterizes the action potential.

Soon thereafter\* Alan Hodgkin and Andrew Huxley, introduced a long electrode into the length of the squid giant axon. They were thus\* able to show that the action potential not only increases (as\* had been predicted by Bernstein), but overshoots and reverses the resting potential by 50 mV. This\* was a remarkable discovery for which scientists had no explanation. The answer had to wait until the end of World War II, when in 1951 Hodgkin and Huxley, working in collaboration with Bernard Katz, found that the action potential gave rise initially to an inward current, due to the flux of sodium ions ( $\text{Na}^+$ ), followed by an outward current, due to the flow of potassium ions ( $\text{K}^+$ ). Their model, which was developed well before the advent of electron microscopes or computer simulations, gave

scientists a basic understanding of how nerve cells work<sup>2</sup>. For their research, they were awarded a Nobel Prize in 1963.

It\* is now known that an unactivated nerve fibre maintains a state of chemical stability with concentrations of potassium inside and outside the lining membrane in a ratio of 30 : 1. Thus the nerve fibre at rest is electrically charged. A nerve impulse is a wave of depolarization created by a chemical imbalance\*. Sodium ( $\text{Na}^+$ ) passes through the membrane, releasing potassium ( $\text{K}^+$ ). The depolarization of any part of the nerve cell causes the depolarization of the next segment, and so on to the end of the fibre.

<sup>2</sup> <http://www.swarthmore.edu/NatSci/echeeve1/Ref/HH/HHmain.htm>



### Ionic Environments of the Membrane<sup>3</sup>

	Ion	Intracellular Concentration (mM)	Extracellular Concentration (mM)
Squid axon	K <sup>+</sup>	400	20
	Na <sup>+</sup>	50	440
	organic anions	110	–
Frog motoneuron	K <sup>+</sup>	140	2.5
	Na <sup>+</sup>	10	117.5
	organic anions	~74	~13
Cat motoneuron	K <sup>+</sup>	150	5.5
	Na <sup>+</sup>	15	150

### What do the following words refer to ?

- "no means available at the time to test it\* experimentally" → "It" refers to ...
- "it\* allowed scientists to insert electrodes" → "It" refers to ...
- "which\* previously\* was impossible" → "Which" refers to ...
- "which\* previously\* was impossible" → "Previously" means before ...
- "which\* positively indicated, for the first time, ..." → "Which" refers to ...
- "Soon thereafter\*" → "Thereafter" means after ...
- "as\* had been predicted by Bernstein" → "As" means that it had been predicted by Bernstein that ...
- "They were thus\* able to show" → "Thus" means by ...
- "This\* was a remarkable discovery" → "This" refers to ...
- "It\* is now known" → "It" refers to ...
- "created by a chemical imbalance\*" → The "imbalance" is between the concentrations of ...

### True or False ? (Be ready to explain and discuss).

- Luigi Galvani described the effect of electricity in frogs' legs as "saltatory conduction".
- When a nerve cell is excited, ions pass through the membrane freely.
- At rest, the concentration of potassium inside the membrane of a nerve fiber is 30 times greater than the concentration of sodium outside the membrane.
- During the action potential, the nerve fiber is positively charged because there is more sodium inside the membrane than potassium.

<sup>3</sup> <http://www.unmc.edu/physiology/Mann/mann3a.html>

viii. Within 1-2 milliseconds after the action potential, the nerve fiber re-establishes a concentration of potassium inside the lining membrane 30 times greater than outside.

Questions : (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.

HOW LONG – WHO – HOW – WHAT HAPPENS – WHEN

5. *History of scientists' knowledge of electricity in the nervous system to the present.* → ...

transmit – two hundred years – since – first – effects – frog

Scientists ...

6. *The origin of the "ionic hypothesis". The way in which this hypothesis was verified experimentally.* → ...

hypothesized – movement – through – responsible for – not until – able to – by – inside – measure

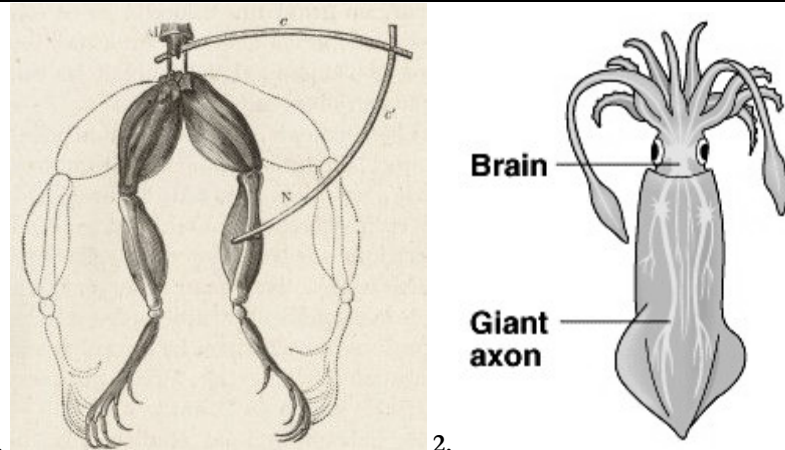
Although Bernstein ...

7. *The process of "depolarization". The moment at which nerve fibers are positively charged.* → ...

negatively – During – positively – due to – influx – just before – After – milliseconds – thanks to – pump

While at rest, ...

8. Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.



1. **Experiment devised by Luigi Galvani (1791)** – When two different metals such as copper (Cu) and zinc (Zn) are immersed in an electrolyte, zinc loses electrons while copper gains electrons thus creating the electric current in a voltaic cell or "battery". This effect was first observed by Luigi Galvani who discovered that a dissected frog leg continued to contract when it was touched with an arc composed of copper and zinc. In "De viribus electricitatis in motu musculari commentarius", Galvani hypothesized that the frog's legs contained a sort of vital electric "fluid". In fact, Galvani had created a frog-battery. 2. **The common Atlantic squid (*Loligo pealeii*)** is a model organism in neuroscience and was used by Andrew Huxley and Alan Hodgkin in their studies on axons. The squid axon is very large in diameter because it is unmyelinated. The increased diameter of the squid axon decreases the internal resistance, thus allowing action potentials to travel faster and improving the squid's escape response<sup>5</sup>. The 0.5mm unmyelinated giant axon of the squid requires 5,000 times as much energy and occupies about 1,500 times as much space as the myelinated frog nerve<sup>6</sup>.

<sup>4</sup> <http://www.bio.miami.edu/~cmallery/150/neuro/48x13SGA.gif>

<sup>5</sup> [http://en.wikipedia.org/wiki/Squid\\_axon](http://en.wikipedia.org/wiki/Squid_axon)

<sup>6</sup> <http://www.ncbi.nlm.nih.gov/books/NBK27954/>



Fundamentals of neuronal signaling : synaptic transmission

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

75. 1. The extension of the three-dimensional field in which all matter exists. 2. An empty area : \_\_\_\_\_
76. As it can be supposed : \_\_\_\_\_
77. A momentary change in electrical potential (as between the inside of a nerve cell and the extracellular medium) that occurs when a cell or tissue has been activated by a stimulus : \_\_\_\_\_
78. To pass from one side to the other : \_\_\_\_\_
79. 1. A space between objects or points ; 2. a break in continuity; interruption : \_\_\_\_\_
80. To establish : \_\_\_\_\_
81. An aggregation of morphologically similar cells and associated intercellular matter acting together to perform specific functions in the body. There are four basic types : muscle, nerve, epidermal (epithelial), and connective : \_\_\_\_\_
82. A brief stop in an activity or action. An interval or space resulting from a suspension. A rupture or interruption : \_\_\_\_\_
83. To direct attention or indicate. To turn the mind or thought in a particular direction or to a particular conclusion : \_\_\_\_\_
84. In the inner part or parts of; inside : \_\_\_\_\_
85. In a very impressive manner : \_\_\_\_\_
86. The junction across which a nerve impulse passes from an axon terminal to a neuron, muscle cell, or gland cell. : \_\_\_\_\_
87. 1. To guide or direct in a course 2. To tend toward a certain result : \_\_\_\_\_
88. A period of time considered as being of a distinctive character; epoch : \_\_\_\_\_
89. A derivative of choline,  $C_7H_{17}NO_3$ , that is released at autonomic synapses and neuromuscular junctions in the somatic and parasympathetic nervous systems and is involved in the transmission of nerve impulses in the body : \_\_\_\_\_
90. A crystalline alkaloid,  $C_{15}H_{21}N_3O_2$ , extracted from the Calabar bean, used in medicine as a miotic (causing constriction of the pupil of the eye) and cholinergic agent (involving acetylcholine) and to enhance memory in patients with Alzheimer's disease. Also called physostigmine : \_\_\_\_\_
91. To decrease, limit, or block the action or function of (an enzyme or organ, for example) : \_\_\_\_\_
92. An enzyme found chiefly (principally) at nerve terminals that inactivates acetylcholine by hydrolyzing it to form acetic acid and choline : \_\_\_\_\_
93. To subject to decomposition by reaction with water, involving the splitting of a bond and the addition of the hydrogen cation and the hydroxide anion of water : \_\_\_\_\_

94. By human means rather than a natural process : \_\_\_\_\_
95. To excite to activity. To increase the activity of (a body organ or part) by a stimulus : \_\_\_\_\_
96. Progressively growing greater or larger : \_\_\_\_\_
97. To bring into contact; put on : \_\_\_\_\_
98. A very small, narrow, calibrated glass tube used in microinjection : \_\_\_\_\_
99. The junction of an efferent nerve fiber and the muscle fiber plasma membrane. also called myoneural junction : \_\_\_\_\_
100. Exceptionally small; tiny : \_\_\_\_\_
101. In a different or another place : \_\_\_\_\_
102. A reaction, as that of an organism or a mechanism, to a specific stimulus : \_\_\_\_\_
103. To discover or ascertain (determine) the existence, presence, or fact of something : \_\_\_\_\_
104. Carrying impulses from the central nervous system to the periphery of the body. : \_\_\_\_\_
105. A usually voluntary muscle made up of elongated, multinucleated, transversely striated muscle fibers, having principally bony attachments. : \_\_\_\_\_
106. To register or indicate information on a scale : \_\_\_\_\_
107. 1. A substance used in the diagnosis, treatment, or prevention of a disease or as a component of a medication. 2. A chemical substance, such as a narcotic or hallucinogen, that affects the central nervous system, causing changes in behavior and often addiction. : \_\_\_\_\_
108. 1. A dark resinous extract obtained from several tropical American woody plants, especially *Chondrodendron tomentosum* or certain species of *Strychnos*, used as an arrow poison by some Indian peoples of South America. 2. A purified preparation or alkaloid obtained from *Chondrodendron tomentosum*, used in medicine and surgery to relax skeletal muscles. : \_\_\_\_\_
109. Impairment or loss of voluntary muscle function or of sensation in a part or area of the body, usually caused by a lesion or disorder of the muscles or the nerves supplying them : \_\_\_\_\_
110. An occurrence, circumstance, or fact that is perceptible by the senses. : \_\_\_\_\_
111. 1. To come into being; originate 2. To result (from), originate : \_\_\_\_\_
112. Preceding in time or order : \_\_\_\_\_
113. A chemical substance, such as norepinephrine, acetylcholine or dopamine, that transmits nerve impulses across a synapse : \_\_\_\_\_
114. To be inherently present in : \_\_\_\_\_
115. A membranous and usually fluid-filled pouch (especially, a small secretory sac that contains a neurotransmitter, is found inside an axon near the presynaptic membrane,



and releases its contents into the synaptic cleft after fusing with the membrane) :

116. The structure in which the distal end of the axon of a nerve fiber terminates (distal = situated farthest away from the center or origin) : \_\_\_\_\_
117. To change or make different; modify : \_\_\_\_\_
118. To set in motion. To begin a process. : \_\_\_\_\_
119. 1. To put to use or effect 2. To apply, exercise on : \_\_\_\_\_
120. A molecular structure or site on the surface or interior of a cell that binds with substances such as hormones, antigens, drugs, or neurotransmitters. : \_\_\_\_\_
121. A mechanism for opening or closing a protein channel in a cell membrane, regulated by a signal such as increased concentration of a neurotransmitter, change in electrical potential, or physical binding of a ligand molecule to the protein to cause a conformational change in the protein molecule. : \_\_\_\_\_
122. 1. A tubular passage for liquids, etc. 2. A pathway through a protein molecule in a cell membrane that modulates the electrical potential across the membrane by controlling the passage of small inorganic ions into and out of the cell : \_\_\_\_\_
123. Included in the group or class of : \_\_\_\_\_
124. A substance with a distinct molecular composition : \_\_\_\_\_
125. To carry out an action. To operate or function in a specific way : \_\_\_\_\_
126. A substance  $C_8H_{11}NO_3$ , both a hormone and neurotransmitter, secreted by the adrenal medulla and the nerve endings of the sympathetic nervous system to cause vasoconstriction and increases in heart rate, blood pressure, and the sugar level of the blood. It is the chemical means of transmission across synapses in postganglionic neurons of the sympathetic nervous system and in some parts of the central nervous system, is a vasopressor hormone of the adrenal medulla, and is a precursor of epinephrine in its major biosynthetic pathway. Also called norepinephrine : \_\_\_\_\_
127. To break up; demolish : \_\_\_\_\_
128. Proteins produced by living organisms and functioning as biochemical catalysts : \_\_\_\_\_
129. To take on an electrical charge again : \_\_\_\_\_
130. In less time than ; in no more time than : \_\_\_\_\_
131. One thousandth ( $10^{-3}$ ) of a second : \_\_\_\_\_

Usually<sup>7</sup>, however, the end of a nerve fibre is not structurally joined to the next cell. The electron microscope has shown that a space separates the end of an axon from the cell to which\* the impulse is transmitted. Presumably, therefore\*, the potential cannot cross the gap\* directly. Indeed, when a microelectrode is

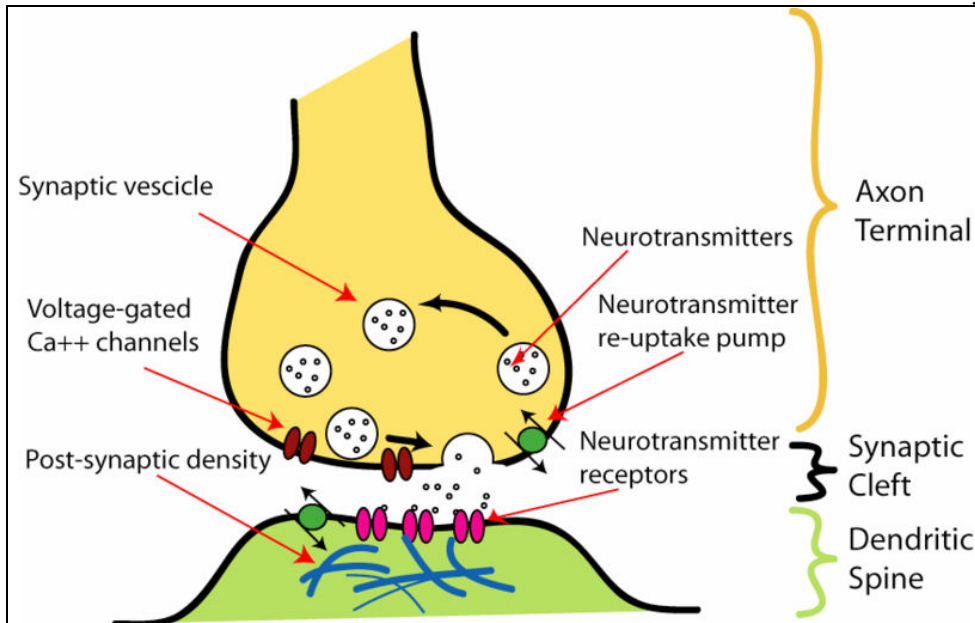
placed between the nerve fibre and the muscle cell at the point of junction, it\* can be shown that the axon potential arrives at the junction about 0.8 msec before the potential is set up in the post junctional tissue. This\* break in electrical continuity points to some form of non-electrical transmission at the junction.

Although the action potential is the key mechanism for the propagation of signals within neurons, the principle of signaling changes dramatically at the "synapse", i.e. the site where the action potential in the presynaptic neuron gives rise to an electrical potential in the postsynaptic cell. Thus, the second advance that led to the modern era of neuroscience was the understanding of the mechanism of synaptic transmission.

In synapses like the neuromuscular synapse, it\* has been shown experimentally that chemicals such as acetylcholine are involved in the transmission. For example, eserine is a substance that inhibits cholinesterase (a.k.a. acetylcholinesterase), an enzyme which hydrolyses acetylcholine. If eserine is added and the nerve fibre is artificially stimulated, an increasing amount of acetylcholine is released from the end of the fibre. When acetylcholine is applied by micropipette to the muscle fibre on the precise point of neuromuscular junction, even minute amounts\* can excite the muscle fibre. When applied\* elsewhere\* on the muscle, however, no response is detected.

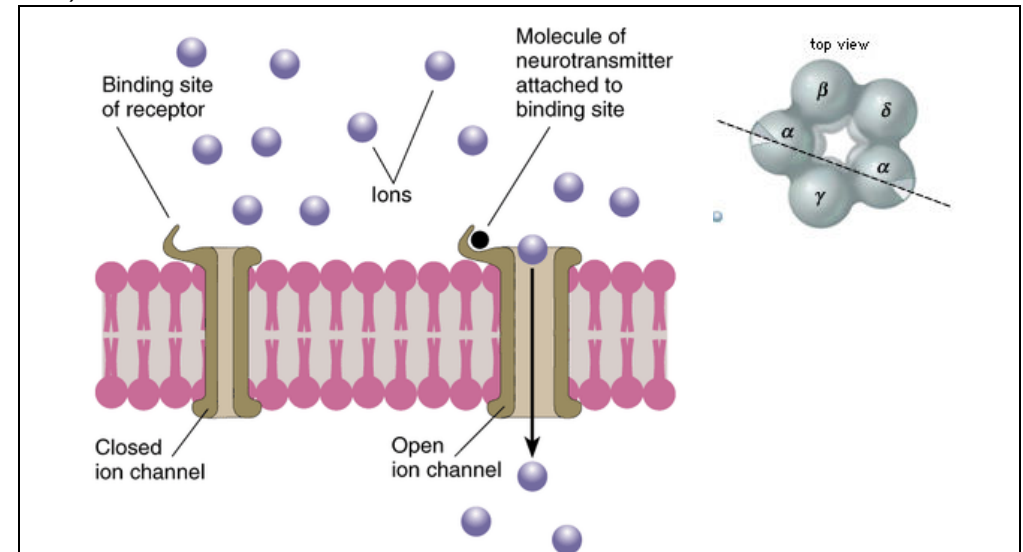
In the 1950s, following the development of techniques for intracellular recording and the establishment of the ionic hypothesis, Paul Fatt and Bernard Katz analyzed the synapse between efferent motor neurons and skeletal muscles of the frog. Using microelectrodes, Katz and Fatt stimulated the nerve and recorded the potential in the presence of several drugs. They found that the potential was extended in time by eserine. In other words, inhibiting cholinesterase allowed acetylcholine to depolarize the muscle longer. Moreover, the potential was blocked completely by curare, a drug known to prevent muscle contraction causing paralysis. Katz also discovered that nerve endings secrete acetylcholine in specific amounts or "quanta", for which he received the Nobel prize in 1970.

<sup>7</sup> Cf. "gap junctions" infra.



**The synapse** – An action potential causes calcium ( $\text{Ca}^{++}$ ) to enter, triggering the release of neurotransmitters. These neurotransmitters attach to receptors, exciting or inhibiting the postsynaptic neuron. After their separation from receptors, neurotransmitter molecules are taken up again into the presynaptic terminal to be recycled.

This\* phenomenon arises, scientists now know, because, prior to their\* release, transmitter molecules reside in packages known as synaptic vesicles. Indeed, when the nerve fibre ending is depolarized, a transmitter is liberated from the vesicles at the end of the fibre. This substance crosses the gap and alters the permeability of the post-junctional cell membrane, thus\* initiating another potential. Transmitters exert their excitatory or inhibitory effects by activating specific receptors on the membrane of the postsynaptic cell, which\* leads to the opening of chemically-gated (ligand-gated) ion channels. Among the most important chemicals which act as transmitters are acetylcholine and noradrenaline. Once the synapse has been made, these\* chemicals are rapidly destroyed by enzymes such as cholinesterase, and the nerve fibre itself recharges within milliseconds.



**Ionotropic receptor<sup>8</sup>:** The Ligand-gated ion channels, also referred to as LGICs, or ionotropic receptors, are opened in response to the binding of a chemical messenger. The prototypic ligand-gated ion channel is the nicotinic acetylcholine receptor, found in the central nervous system and the peripheral nervous system as well as in the neuromuscular junctions of somatic muscles. It consists of a pentamer of protein subunits, with two binding sites for acetylcholine, which alter the receptor's configuration and cause an internal pore to open. This pore allows  $\text{Na}^+$  ions to flow down into the cell. With a sufficient number of channels opening, the intracellular  $\text{Na}^+$  concentration rises to the point at which the positive charge within the cell is enough to depolarize the membrane, and an action potential is initiated.

**What do the following words refer to ?**

- q. "to which\* the impulse is transmitted" → "Which" refers to ...
- r. "Presumably, therefore\*, the potential cannot cross the gap\* directly" → "Therefore" refers to the fact that ...
- s. "the potential cannot cross the gap\* directly" → "The gap" is the same as ...
- t. "it can be shown" → "It" refers to ...
- u. "This\* break in electrical continuity" → "This break" refers to ...
- v. "it\* has been shown experimentally" → "It" refers to ...
- w. "even minute amounts\* can excite the muscle fibre" → These "amounts" are quantities of ...
- x. "When\* applied\*" → means "When \_\_\_\_\_ applied"
- y. "elsewhere\* on the muscle" means at other points than ...

<sup>8</sup> Image source(s) :

<http://homepage.psy.utexas.edu/homepage/class/Psy332/Salinas/Neurotransmission/Neurotrans.html>;

<http://cache.eb.com/eb/image?id=54741>

- z. *"This\* phenomenon arises"* → "This phenomenon" refers to ...  
 aa. *"prior to their\* release"* → "Their" refers to ...  
 bb. *"thus\* initiating another potential"* → "Thus" means that the new potential is initiated by...  
 cc. *"which\* leads to the opening of chemically-gated ion channels"* → "Which" refers to ...  
 dd. *"these\* chemicals are rapidly destroyed"* → "These chemicals" refers to ...

**True or False ? (Be ready to explain and discuss).**

- ix. *Acetylcholine allows Na<sup>+</sup> ions to enter the nerve cell through its receptor.*  
 x. *Cholinesterase is an essential component of the neuro-muscular synapse.*  
 xi. *Eserine (a.k.a. physostigmine) acts physiologically as an antidote to curare.*

**Questions : (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.**

WHAT SORT – HOW (×2) – WHERE – WHY – WHAT HAPPENS

**9. Type of connection between nerve fibers and other cells. → ...**

structural – between – and other – as a result – directly – as evidenced by<sup>9</sup> – continuity

*In general, there is...*

**10. Experimental evidence of chemical transmission in the junction. → ...**

which – hydrolysis – amount – and – extended – time – Moreover – such as – block – Thus – mechanism of – shown – chemical

*In the presence of ...*

**11. Area(s) in which acetylcholine is effective in stimulating the muscle. The reason for this. → ...**

only – at – junction – and not – because – activate – specific – found only

*Acetylcholine...*

**12. The action of neurotransmitters in synaptic transmission. The final step after a synapse is made. → ...**

released from – when – then – bind to – postsynaptic – and – permeability – by – Finally – broken down – or – again – recycled

*Transmitters ...*

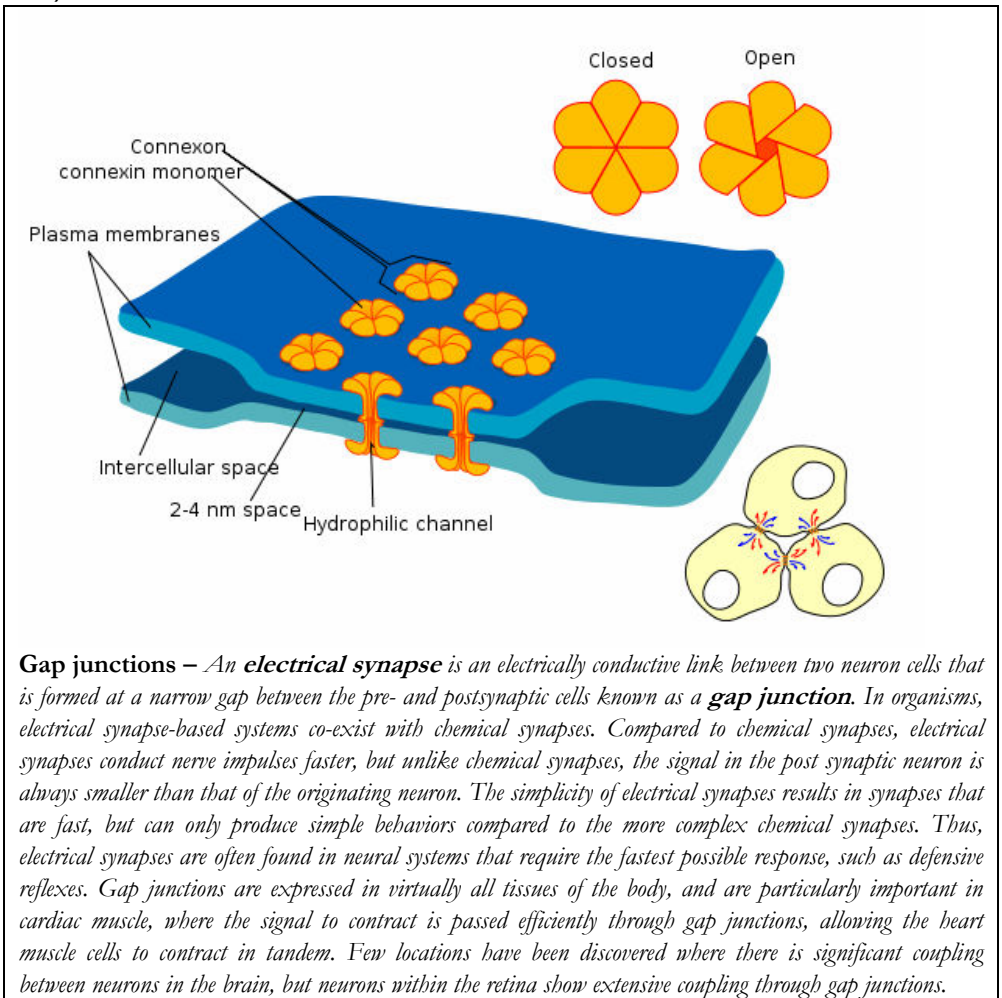
**13. Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.**

<sup>9</sup> NB. as evidenced by ⇒ *comme le montre...* (*m.à m. "comme démontré par"*)

**From synapse to action potential – Complete the following table :**

and becomes positive – begins to decrease – close – close – electrical potential – electrical potential – electrical potential increases – in response to Ach – in the axon – Ligand-gated channels – Na<sup>+</sup> ions begin to pass – Na<sup>+</sup> ions enter – Na<sup>+</sup>-K<sup>+</sup> pump – open – open – open – open – resting potential – restores – stops increasing – the axon – through the post-synaptic membrane – Voltage-gated K<sup>+</sup> channels – Voltage-gated K<sup>+</sup> channels – Voltage-gated Na<sup>+</sup> channels – Voltage-gated Na<sup>+</sup> channels

Voltage	Events
- 70 mV → - 40 mV	
- 40 mV → + 50 mV	
+ 50 mV → - 90 mV	
- 90 mV → - 70 mV	



Chemical Transmission in the Autonomic Nervous System

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

- 132.** Muscle tissue that contracts without conscious control, having the form of thin layers or sheets made up of spindle-shaped, unstriated cells with single nuclei and found in the walls of the internal organs, such as the stomach, intestine, bladder, and blood vessels, excluding the heart : \_\_\_\_\_
- 133.** A cell, group of cells, or organ of endothelial origin that selectively removes materials from the blood, concentrates or alters them, and secretes them for further use in the body or for elimination from the body : \_\_\_\_\_
- 134.** The specialized striated muscle tissue of the heart; the myocardium : \_\_\_\_\_
- 135.** To adjust (a mechanism) for accurate and proper functioning : \_\_\_\_\_
- 136.** To extend on all sides simultaneously; encircle : \_\_\_\_\_
- 137.** Outside a cell : \_\_\_\_\_
- 138.** A systematic examination; research, exploration : \_\_\_\_\_
- 139.** 1. A division of space on a surface; a region. 2. A division of experience, activity, or knowledge; a field, domain : \_\_\_\_\_
- 140.** 1. To a greater extent; more. 2. In addition; furthermore : \_\_\_\_\_
- 141.** A substance, usually a peptide or steroid, produced by one tissue and conveyed by the bloodstream to another to effect physiological activity, such as growth or metabolism : \_\_\_\_\_
- 142.** To change in form or character; alter : \_\_\_\_\_
- 143.** An assemblage (group) of things making up a unit : \_\_\_\_\_
- 144.** The part of the autonomic nervous system originating in the brain stem and the lower part of the spinal cord that, in general, inhibits or opposes the physiological effects of the sympathetic nervous system, as in tending to stimulate digestive secretions, slow the heart, constrict the pupils, and dilate blood vessels. : \_\_\_\_\_
- 145.** The part of the autonomic nervous system that is concerned especially with preparing the body to react to situations of stress or emergency, that contains adrenergic fibers and tends to depress secretion, decrease the tone and contractility of smooth muscle, increase heart rate, and that consists essentially of preganglionic fibers arising in the thoracic and upper lumbar parts of the spinal cord : \_\_\_\_\_
- 146.** Producing activity in an organ, a tissue, or a part, as a result of stimulation : \_\_\_\_\_
- 147.** Suppressing or limiting activity : \_\_\_\_\_
- 148.** The part of the nervous system that regulates involuntary action, as of the intestines, heart, and glands, and that is divided into the sympathetic nervous system and the parasympathetic nervous system. : \_\_\_\_\_
- 149.** The number of heartbeats per unit of time, usually expressed as beats per minute. : \_\_\_\_\_

- 150.** Frequency of breathing, expressed as the number of breaths per minute. : \_\_\_\_\_
- 151.** 1. The fluid, consisting of water with small amounts of urea and salts, that is excreted through the pores of the skin by the sweat glands; sweat. 2. The sensible elimination of fluid through the pores of the skin, which is visible as droplets on the skin, for regulation of body temperature or in response to emotional stress. : \_\_\_\_\_
- 152.** A state of being responsive to sensory stimulation : \_\_\_\_\_
- 153.** The passage of air into and out of the lungs to supply the body with oxygen : \_\_\_\_\_
- 154.** Capable of responding to sensory stimuli; awake, alert; aware of one's external environment. : \_\_\_\_\_
- 155.** The human consciousness that originates in the brain and is manifested especially in thought, perception, emotion, will, memory, and imagination. : \_\_\_\_\_
- 156.** A physiological reaction in response to stress, characterized by an increase in heart rate and blood pressure, elevation of glucose levels in the blood, and redistribution of blood from the digestive tract to the muscles. These changes are caused by activation of the sympathetic nervous system by epinephrine (adrenaline), which prepares the body to challenge or flee from a perceived threat. : \_\_\_\_\_
- 157.** To turn aside from a course or direction : \_\_\_\_\_
- 158.** The movement of blood through the vessels : \_\_\_\_\_
- 159.** The digestive tract, the tubular passage of mucous membrane and muscle extending about 8.3 meters from mouth to anus; functions in digestion and elimination : \_\_\_\_\_
- 160.** The tissue forming the outer covering of the body, consisting of two layers the dermis, and epidermis : \_\_\_\_\_
- 161.** Decrease in the diameter of blood vessels, caused by a nerve or drug : \_\_\_\_\_
- 162.** Two spongy, saclike respiratory organs in most vertebrates, occupying the chest cavity together with the heart and functioning to remove carbon dioxide from the blood and provide it with oxygen. : \_\_\_\_\_
- 163.** To intensify or increase in quality, value, power, etc.; improve : \_\_\_\_\_
- 164.** To contribute to the progress or growth of : \_\_\_\_\_
- 165.** An elastic tubular channel, such as an artery, a vein, or a capillary, through which the blood circulates. : \_\_\_\_\_
- 166.** The wavelike muscular contractions of the alimentary canal or other tubular structures by which contents are forced onward toward the opening. : \_\_\_\_\_
- 167.** One of the upper chambers of the heart that receives blood from the veins and forces it into a ventricle. : \_\_\_\_\_
- 168.** A small mass of specialized cardiac muscle fibers located in the posterior wall of the right atrium of the heart that acts as a pacemaker by generating at regular intervals the electric impulses of the heartbeat. : \_\_\_\_\_

**169.** A small mass of specialized cardiac muscle fibers, located in the wall of the right atrium of the heart, that receives heartbeat impulses from the sinoatrial node and directs them to the walls of the ventricles. : \_\_\_\_\_

In tissue such as smooth muscle, glands and cardiac muscle, the nerves regulate rather than initiate activity. With tissue of this kind\* no synaptic junctions are made, but the nerve fibres form plexuses within the tissue, the chemical transmitter being released into the surrounding extracellular space. Investigations into chemical transmission in this area\* are further complicated by the action of hormones, which may considerably modify the response of the tissue to nervous stimulation. Many smooth muscles are supplied by two sets of nerve fibres, one set releasing acetylcholine (the parasympathetic nervous system) and the other\* noradrenaline (the sympathetic nervous system). These chemicals\* oppose each other, one being excitatory and the other inhibitory. Once released, noradrenaline and adrenaline bind to adrenergic receptors (divided into  $\alpha$  and  $\beta$  subtypes). Acetylcholine acts on two types of receptors, muscarinic and nicotinic receptors.

Together, the sympathetic and parasympathetic nervous systems form the **autonomic nervous system** (ANS)<sup>10</sup>. The ANS affects heart rate, digestion, respiration rate, salivation, perspiration, diameter of the pupils, micturition (urination), and sexual arousal. Whereas most of its actions are involuntary, some, such as breathing, work in tandem with the conscious mind. The sympathetic nervous system promotes a "fight or flight" response, corresponds with arousal and energy generation, and inhibits digestion. It diverts blood flow away from the gastro-intestinal (GI) tract and skin via vasoconstriction, whereas blood flow to skeletal muscles and the lungs is enhanced. The parasympathetic nervous system promotes a "rest and digest" response. It dilates blood vessels leading to the GI tract, increasing blood flow, stimulates salivary gland secretion, and accelerates peristalsis. Parasympathetic activity slows the heart rate, reducing contractility in the atria, and reducing conduction velocity of the sinoatrial node (SA node) and atrioventricular node (AV node). The parasympathetic system also stimulates sexual arousal.

Target	Sympathetic receptor/effect	Parasympathetic receptor/effect
Heart : Atrial cardiac muscle	$\beta 1$ : increases contractility	M2 : decreases contractility
Heart : Ventricular cardiac muscle	$\beta 1$ : increases contractility (inotropic) increases cardiac muscle automaticity	–
Heart : SA node	$\beta 1$ : increases conduction	M2 : decreases conduction
Lungs : smooth muscles of bronchioles	$\beta 2$ : relaxes	M3 : contracts
GI tract : smooth muscle) motility	$\alpha 1$ , $\alpha 2$ , $\beta 2$ : decreases	M3 : increases
GI tract : glands	–	M3 : secretes
Stomach : parietal cells	–	M1 : gastric acid secretion
Eye : Pupil dilator muscle	$\alpha 1$ : contracts, causes mydriasis (dilation)	M3 : relaxes, causes miosis (constriction)
Eye : Ciliary muscle (focusing)	$\beta 2$ : relaxes (causes long-range focus)	M3 : contracts (causes short-range focus)
Arteries to viscera	$\alpha$ : constricts	–
Arteries to skeletal muscle	$\beta 2$ : dilates	–
Arteries to erectile tissue	$\alpha 1$ : constricts	M3 : dilates
Uterus	$\alpha 1$ : contracts (pregnant) $\beta 2$ : relaxes (non-pregnant)	–
Genitalia	$\alpha 1$ : contracts (ejaculation)	M3 : erection

What do the following words refer to ?

ee. "With tissue of this kind no synaptic junctions are made" → "This kind" refers to ...

ff. "one set releasing acetylcholine and the other noradrenaline" → "One" and "the other" refer to ...

gg. "These chemicals oppose each other" → "These chemicals" refers to ...

hh. "Investigations into chemical transmission in this area are further complicated" → "This area" refers to ...

<sup>10</sup> NB. The enteric nervous system, which is embedded in the lining of the gastrointestinal tract and directly controls the digestive system, is sometimes considered part of the autonomic nervous system, and sometimes considered as an independent system.

**True or False ? (Be ready to explain and discuss).**

xii. *Noradrenaline is excitatory whereas acetylcholine is inhibitory.*

xiii. *Smooth muscles react to acetylcholine, while cardiac muscle reacts to noradrenaline.*

**Questions :** (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.

HOW (×2) – WHAT

**14. *Differences between* the function of nerves in skeletal muscle and in other muscles (or glands). Structures *that* nerves fibers form in these areas. → ...**

nerves – activity – nerves only – in – such as – smooth – and – thus – no – are made –  
Rather, – fibres – form – which release – into

*Whereas in skeletal muscle...*

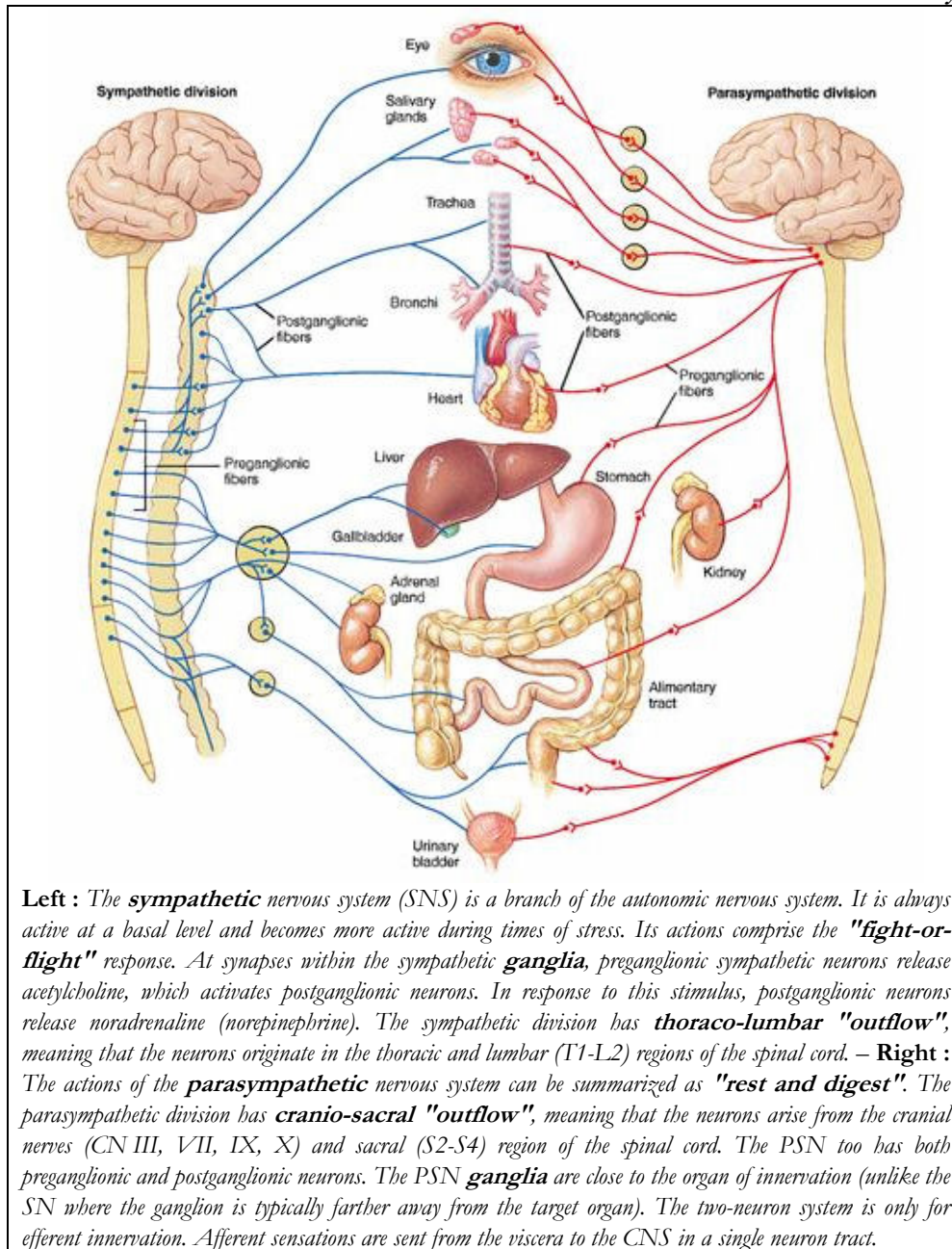
**15. *Ways in which* the ANS regulates activity in peripheral tissues. Receptors *that* ACh and NAd act on in peripheral tissues. → ...**

noradrenaline – receptors – and pupil – bronchioles – and – digestive – in order to – "... " –  
response – Conversely – system – inhibits – heart – and – secretion – as well as – a.k.a. –  
"... " response

*Nerves of ...*

**16. Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.**





Responses of major organs to autonomic nerve impulses :

Organ	Sympathetic Stimulation	Parasympathetic Stimulation
Heart	Increased heart rate beta1 (& beta2)	Decreased heart rate
	Increased force of contraction beta1 (& beta2)	Decreased force of contraction
	Increased conduction velocity	Decreased conduction velocity
Arteries	Constriction (alpha1)	Dilation
	Dilation (beta2)	
Veins	Constriction (alpha1)	
	Dilation (beta2)	
Lungs	Bronchial muscle relaxation (beta2)	Bronchial muscle contraction
		Increased bronchial gland secretions
Gastro-intestinal tract	Decreased motility (beta2)	Increased motility
	Contraction of sphincters (alpha)	Relaxation of sphincters
Liver	Glycogenolysis (beta2 & alpha)	Glycogen synthesis
	Gluconeogenesis (beta2 & alpha)	
	Lipolysis (beta2 & alpha)	
Kidney	Renin secretion (beta2)	
Bladder	Detrusor relaxation (beta2)	Detrusor contraction
	Contraction of sphincter (alpha)	Relaxation of sphincter
Uterus	Contraction of pregnant uterus (alpha)	
	Relaxation of pregnant and non-pregnant uterus (beta2)	
Eye	Dilates pupil (alpha)	Constricts pupil
		Increased lacrimal gland secretions
Submandibular & parotid glands	Viscous salivary secretions (alpha)	Watery salivary secretions

# The Cranial Nerves

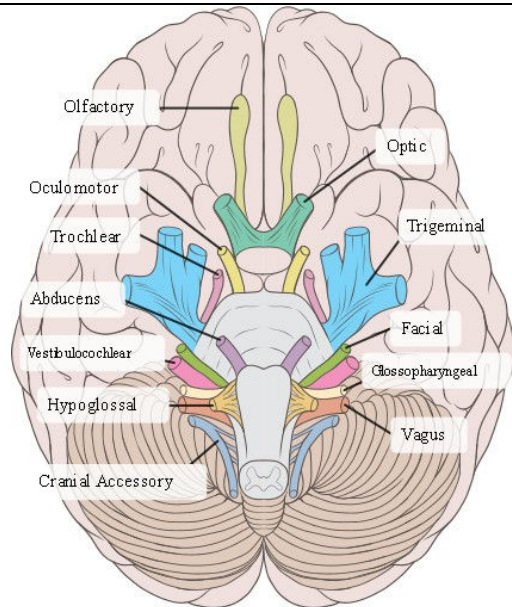
**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

- 170.** The thick, whitish cord of nerve tissue that extends from the medulla oblongata down through the spinal column and from which the spinal nerves branch off to various parts of the body : \_\_\_\_\_
- 171.** In association with or in relationship to one another; mutually or reciprocally : \_\_\_\_\_
- 172.** The part of the nervous system which consists of the brain and spinal cord, to which sensory impulses are transmitted and from which motor impulses pass out, and which supervises and coordinates the activity of the entire nervous system. abbr CNS : \_\_\_\_\_
- 173.** 1. To move upward 2. To come into being; originate. To result, issue, or proceed : \_\_\_\_\_
- 174.** To furnish or provide (something). To serve as a conduit (medium of transmission) : \_\_\_\_\_
- 175.** The nerves outside the central nervous system including the cranial nerves (excepting the optic nerve), the spinal nerves, and the sympathetic and parasympathetic nervous systems : \_\_\_\_\_
- 176.** Called or known by a different name : \_\_\_\_\_
- 177.** A long flexible structure made up of strands or fibers, such as a nerve or tendon : \_\_\_\_\_
- 178.** A cluster (group) or strand (complex of filaments) of closely bound muscle or nerve fibers : \_\_\_\_\_
- 179.** Transmitting impulses from sense organs to nerve centers; afferent : \_\_\_\_\_
- 180.** Carrying impulses from the nerve centers to the muscles : \_\_\_\_\_
- 181.** Two corresponding persons or items, similar in form or function and matched or associated : \_\_\_\_\_
- 182.** Several nerves that arise in pairs from the brainstem and reach the periphery through openings in the skull. There are 12 such pairs in humans : \_\_\_\_\_
- 183.** The nerves that arise in pairs from the spinal cord. There are 31 pairs in the human body : \_\_\_\_\_
- 184.** In the order (previously) mentioned : \_\_\_\_\_
- 185.** The tenth and longest of the cranial nerves, passing through the neck and thorax into the abdomen and supplying sensation to part of the ear, the tongue, the larynx, and the pharynx, motor impulses to the vocal cords, and motor and secretory impulses to the abdominal and thoracic viscera. Also called pneumogastric nerve : \_\_\_\_\_
- 186.** The chambered, muscular organ that pumps blood received from the veins into the arteries, thereby maintaining the flow of blood through the entire circulatory system : \_\_\_\_\_

- 187.** The section of the alimentary canal that extends from the mouth and nasal cavities to the larynx, where it becomes continuous with the esophagus : \_\_\_\_\_
- 188.** The part of the respiratory tract between the pharynx and the trachea, having walls of cartilage and muscle and containing the vocal cords enveloped in folds of mucous membrane : \_\_\_\_\_
- 189.** 1. Continuing ; 2. Temporarily excluded. Not yet dealt with : \_\_\_\_\_
- 190.** To operate or regulate; direct, command : \_\_\_\_\_
- 191.** The globe-shaped portion of the eye formed by the sclera and cornea, surrounded by the socket and covered externally by the eyelids : \_\_\_\_\_
- 192.** To register, receive or indicate sound or images : \_\_\_\_\_
- 193.** Something that may be perceived by the olfactory sense; odor : \_\_\_\_\_

The brain and spine together form the central nervous system. Arising from\* the central nervous system and supplying all parts of the body are the peripheral nerves, commonly referred to simply as nerves. A nerve is a cord-like structure, usually containing bundles of conducting\* fibres, which\* may be sensory or motor.

Twelve pairs of nerves arise from the brain or brainstem, and thirty-one pairs of nerves arise from the spine. These\* are known as the cranial nerves and the spinal nerves respectively. Of the twelve **cranial nerves**, four contain both sensory and motor fibres (V, VII, IX, X). The most important of these\* is the vagus, or tenth nerve, which\* supplies the heart, most of the digestive organs, the pharynx and the larynx. Of the remaining eight pairs of nerves, five contain motor fibres only (III, IV, VI, XI, XII), and three are entirely sensory (I, II, VIII). The third (oculomotor), fourth (trochlear) and sixth (abducens) nerves, for example, control the movement of the eyeball, and the first nerve (olfactory) records smells.



**Inferior view of the brain and brain stem showing the twelve pairs of cranial nerves :**

- I. Olfactory nerve (S)** – conducts impulses from the mucous membranes of the nose to the olfactory bulb.
- II. Optic nerve (S)** – carries visual information from the retina to the thalamus and other parts of the brain
- III. Oculomotor nerve (M)** – motor with some associated autonomic fibers, arises from the midbrain, supplies muscles of the eye with motor fibers, and the ciliary body and iris with autonomic fibers
- IV. Trochlear nerve (M)** – innervates the superior oblique muscles of the eyeballs
- V. Trigeminal nerve (MS)** – controls sensory and motor functions in the face, teeth, mouth, and nasal cavity, a.k.a. trigeminus
- VI. Abducens nerve (M)** – conveys motor impulses to the rectus muscle on the lateral side of each eye, a.k.a. abducent nerve
- VII. Facial nerve (MS)** – controls facial muscles and relay sensation from the taste buds of the front part of the tongue
- VIII. Vestibulo-cochlear nerve (S)** – connects the inner ear with the brain, transmits impulses concerned with hearing and balance, and is composed of the cochlear nerve and the vestibular nerve, a.k.a. called acoustic nerve, auditory-vestibular nerve.
- IX. Glossopharyngeal nerve (MS)** – contains both sensory and motor fibers and supply the tongue, soft palate, pharynx, and parotid gland
- X. Vagus nerve (MS)** – longest of the cranial nerves, passing through the neck and thorax into the abdomen and supplying sensation to part of the ear, the tongue, the larynx, and the pharynx, conveys

motor impulses to the vocal cords, and motor and secretory impulses to the abdominal and thoracic viscera, a.k.a. pneumogastric nerve

**XI. Accessory nerve (M)** – conveys motor impulses to the pharynx and muscles of the upper thorax, back, and shoulders, a.k.a. spinal accessory nerve

**XII. Hypoglossal nerve (M)** – innervates the muscles of the tongue

**What do the following words refer to ?**

- ii. "Arising from the central nervous system" The subject of "arise from" is ...
- jj. "containing bundles of conducting fibres" Another name for a "conducting" fiber is ...
- kk. "which may be sensory or motor" → "Which" refers to ...
- ll. "These are known as" → "These" refers to ...
- mm. "The most important of these is the vagus" → "These" refers to ...
- nn. "which supplies the heart..." → "Which" refers to ...

**True or False ? (Be ready to explain and discuss).**

- xiv. Most of the cranial nerves contain motor fibers.
- xv. Most of the cranial nerves contain sensory fibers.
- xvi. Most of the cranial nerves contain both motor and sensory fibers.
- xvii. The 12 cranial nerves are responsible for conducting signals from the brain to the rest of the body and vice versa.
- xviii. Most of the cranial nerves have a parasympathetic function.

**Questions : (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.**

WHAT (×2) – WHAT KINDS (×2) – WHICH

**17. The "cranial" nerves and their composition. → ...**

including the – kinds of – i.e. both – and – The other – however – only one – that is – either – only – or only

There are ...

18. The most important cranial nerve, *its composition*. Parts of the body *which* it supplies. → ...

or tenth – which – both – and motor – the most – insofar as – supplies – most of the – and

*The...*

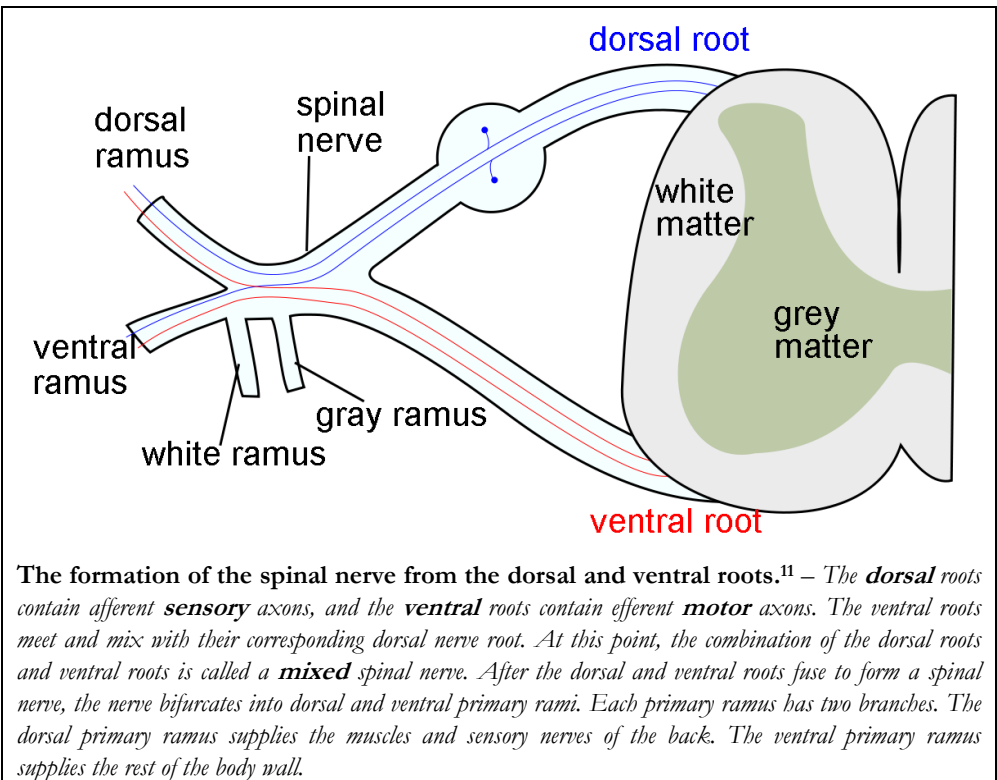
19. Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.

## The Spinal Nerves

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

194. One and the other (at the same time) : \_\_\_\_\_
195. The spinal nerves of the cervical region of which there are eight on each side in humans : \_\_\_\_\_
196. The spinal nerves of the thoracic region that consist of 12 pairs of which one pair emerges just below each thoracic vertebra : \_\_\_\_\_
197. The five pairs of spinal nerves of the lumbar region of which one on each side passes out below each lumbar vertebra and the upper four unite by connecting branches into a lumbar plexus : \_\_\_\_\_
198. The spinal nerves of the sacral region of which there are five pairs and which have anterior and posterior branches passing out through the sacral foramina : \_\_\_\_\_
199. The 31<sup>st</sup> or lowest pair of spinal nerves : \_\_\_\_\_
200. To become separated into parts : \_\_\_\_\_
201. Located behind or toward the rear. Situated toward the hind part of the body (dorsal) : \_\_\_\_\_
202. The membranous tissue forming the external covering or integument of an animal and consisting of the epidermis and dermis : \_\_\_\_\_
203. The posterior portion of the trunk of the human body between the neck and the pelvis; the dorsum : \_\_\_\_\_
204. Located on or near the front of the body. Located on or near the front of an organ or on the ventral surface of the body in human beings : \_\_\_\_\_
205. To make or form a circle around; enclose : \_\_\_\_\_
206. The part of the human body between the neck and the diaphragm, partially encased by the ribs and containing the heart and lungs; the chest : \_\_\_\_\_
207. The short muscles that extend between the ribs filling in most of the intervals between them and serving to move the ribs in respiration : \_\_\_\_\_
208. A structure in the form of a network, especially of nerves, blood vessels, or lymphatics : \_\_\_\_\_
209. A system of lines or channels that cross or interconnect. A complex, interconnected group or system : \_\_\_\_\_
210. To move or extend away from the origin and toward a different point : \_\_\_\_\_
211. Relating to the neck (part of the body joining the head to the shoulders or trunk) : \_\_\_\_\_
212. Relating to the structure of the skeleton, composed of the innominate bones on the sides, the pubis in front, and the sacrum and coccyx behind, that rests on the lower limbs and supports the spinal column : \_\_\_\_\_
213. Higher in place; superior : \_\_\_\_\_

214. Physically situated below; inferior : \_\_\_\_\_
215. One of the jointed appendages, such as an arm or a leg, used for locomotion etc. : \_\_\_\_\_
216. A sensory and motor nerve originating in the sacral plexus and running through the pelvis and upper leg : \_\_\_\_\_
217. To come into existence; grow out of, originate : \_\_\_\_\_
218. A nerve plexus that lies against the posterior and lateral walls of the pelvis, is formed by the union of the lumbosacral trunk and the first, second, and third sacral nerves, and continues into the thigh as the sciatic nerve : \_\_\_\_\_
219. The portion of the human leg between the hip and the knee and supported by a single large bone (the femur) : \_\_\_\_\_
220. The two lower human limbs that extend from the top of the thigh to the foot (especially the part between the knee and the ankle) : \_\_\_\_\_

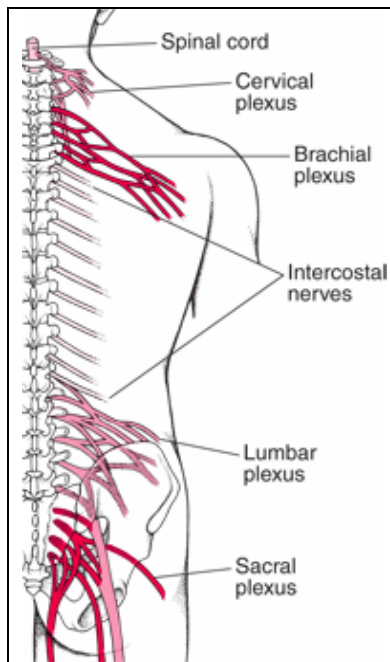


The formation of the spinal nerve from the dorsal and ventral roots.<sup>11</sup> – The **dorsal** roots contain afferent **sensory** axons, and the **ventral** roots contain efferent **motor** axons. The ventral roots meet and mix with their corresponding dorsal nerve root. At this point, the combination of the dorsal roots and ventral roots is called a **mixed** spinal nerve. After the dorsal and ventral roots fuse to form a spinal nerve, the nerve bifurcates into dorsal and ventral primary rami. Each primary ramus has two branches. The dorsal primary ramus supplies the muscles and sensory nerves of the back. The ventral primary ramus supplies the rest of the body wall.

<sup>11</sup> [http://upload.wikimedia.org/wikipedia/commons/d/d2/Spinal\\_nerve.svg](http://upload.wikimedia.org/wikipedia/commons/d/d2/Spinal_nerve.svg)



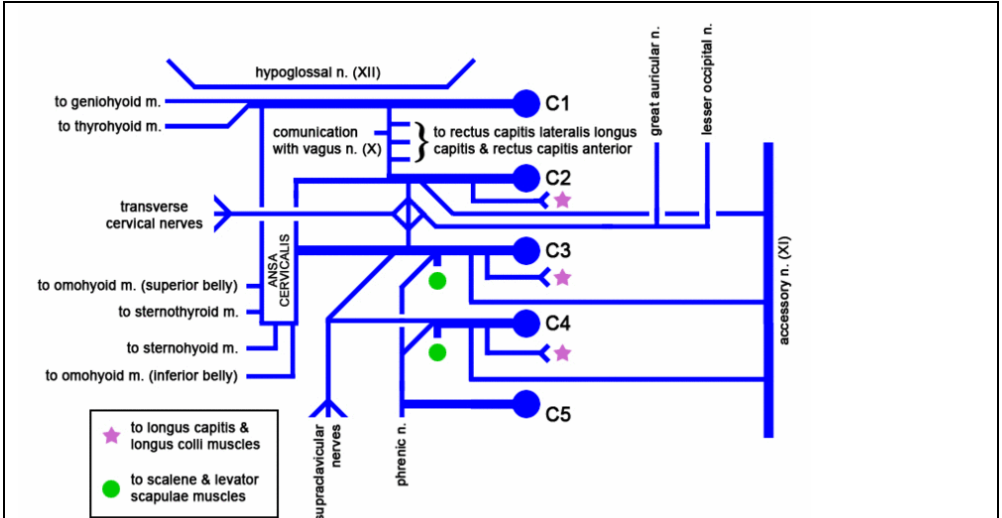
In contrast\*, all the **spinal nerves** contain both sensory and motor fibres. There are eight pairs of cervical nerves, twelve thoracic, five lumbar, five sacral, and one coccygeal. The spinal nerves divide into two branches. The posterior branches serve the muscles and skin of the back of their own\* region. The anterior branches of the thoracic nerves circle the thorax, supplying the intercostal muscles and the skin. All other\* anterior branches form plexuses, or networks of nerve fibres, from which\* nerves pass out to supply the cervical and pelvic regions and the upper and lower limbs. Thus each limb nerve contains fibres from several spinal nerves. The **sciatic nerve**, which emerges from the sacral plexus to serve the back of the thigh and the leg, contains fibres from five spinal nerves : the fourth and fifth lumbar nerves, and the first, second and third sacral nerves.



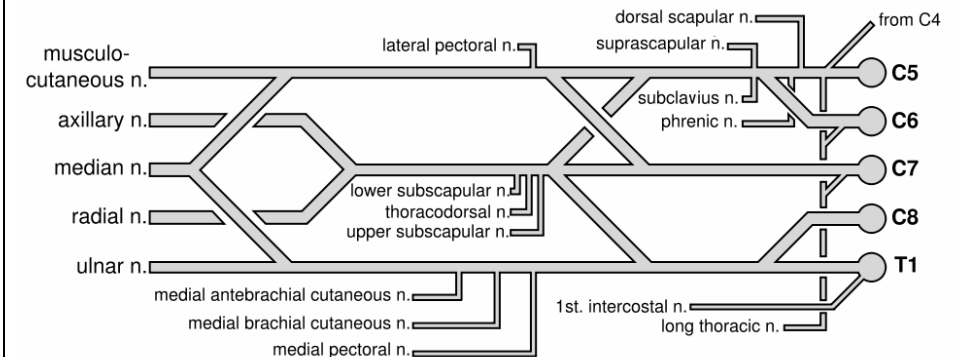
A nerve plexus is a network of interwoven nerves. Nerve fibers from different spinal nerves are combined in plexuses, so that all fibers going to a specific body part are put together in one nerve. Four nerve plexuses are located in the trunk of the body :

- The **cervical plexus** provides nerve connections to the head, neck, and shoulder.
- The **brachial plexus** provides connections to the chest, shoulders, upper arms, forearms, and hands.
- The **lumbar plexus** provides connections to the back, abdomen, groin, thighs, knees, and calves.
- The **sacral plexus** provides connections to the pelvis, buttocks, genitals, thighs, calves, and feet.

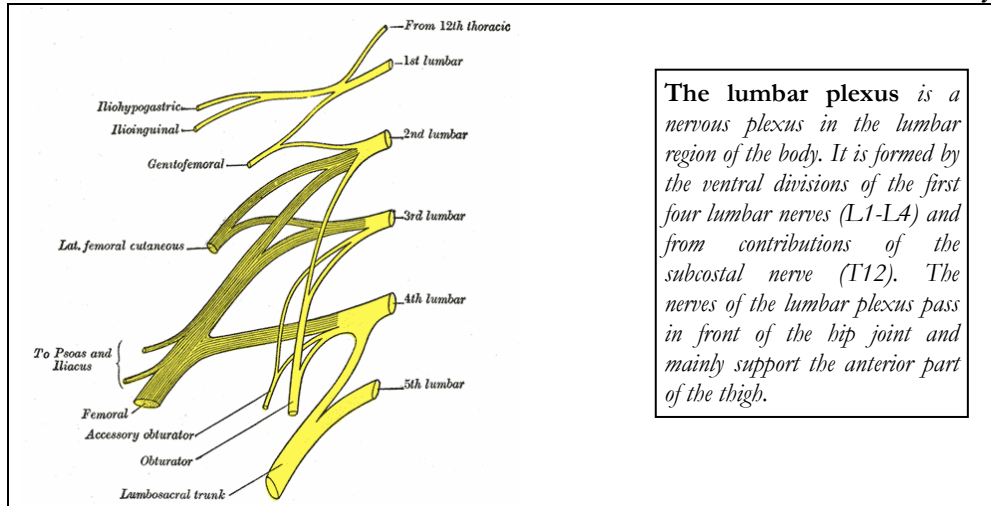
The spinal nerves in the chest do not join a plexus. They are the intercostal nerves, which are located between the ribs.



The **cervical plexus** is a plexus of the ventral rami of the first four cervical spinal nerves which are located from C1 to C4 cervical segment in the neck. Nerves formed from the cervical plexus innervate the back of the head, as well as some neck muscles.



The **brachial plexus** is an arrangement of nerve fibres, running from the spine, specifically from above the fifth cervical vertebra to underneath the first thoracic vertebra (C5-T1). It proceeds through the neck, the axilla (armpit region) and into the arm.



What do the following words refer to ?

oo. "In contrast\*, all the spinal nerves contain both sensory and motor fibres" → "In contrast" means that, insofar as they contain two kinds of fibers, the spinal nerves are different from...

pp. "of their own region" → "Their own" refers to ...

qq. "All other anterior branches form plexuses" → The "other" anterior branches are the branches of the ...

rr. "from which nerves pass out" → "Which" refers to ...

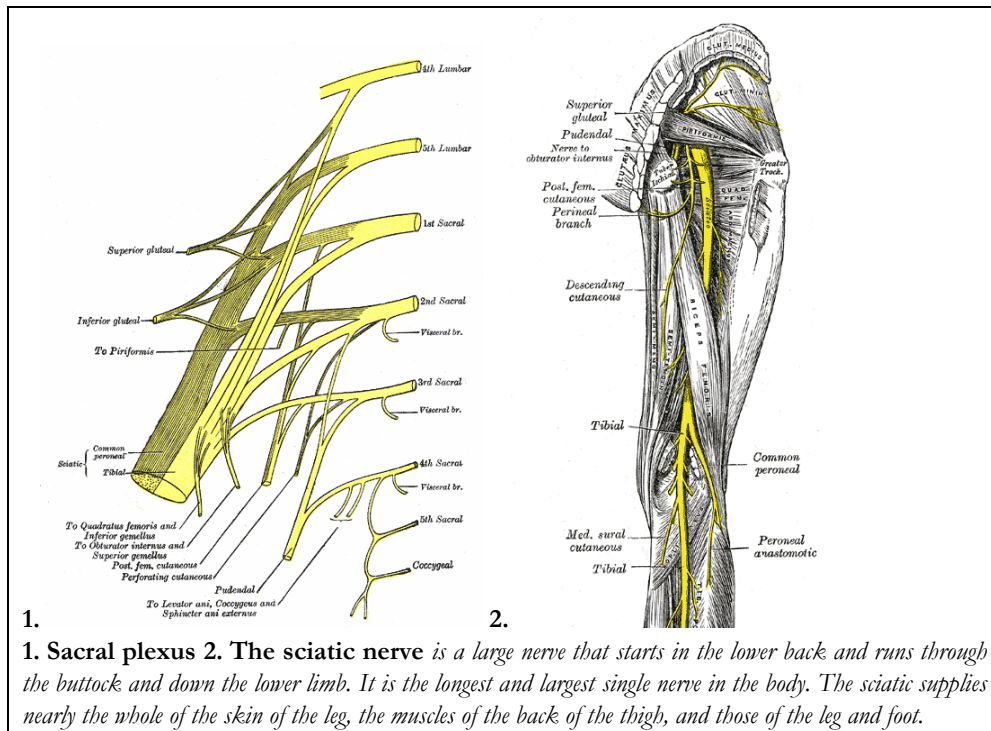
**True or False ? (Be ready to explain and discuss).**

xx. Most spinal nerves contain both motor and sensory fibers.

xx. Limb nerves contain nerve fibers from different regions of the spinal column.

xxi. The anterior branches of the spinal nerves contain motor fibers only, whereas the posterior branches contain sensory fibers only.

xxii. The nerves of the sympathetic nervous system originate in the spinal column.



**Questions : (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.**

HOW MANY (×2) – HOW – WHAT – WHY

20. The composition and structure of the spinal nerves. → ...

all of the – two types – i.e. both – into – the posterior – which serve – and the – which – intercostal – regions – and

Unlike most of...

21. The formation/structure of limb nerves. The reason for this. → ...

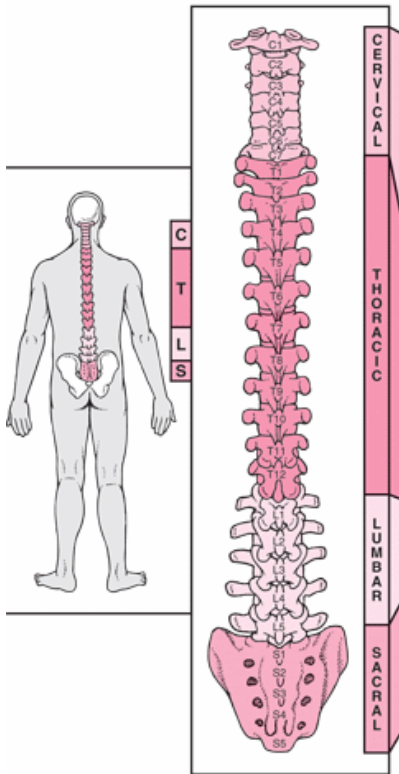
from several – since – anterior – most – (except for – ...) – form – known as – from which – such as the

Limb nerves are...



22. Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.

**Effects of Spinal Injury**



Level of Injury	Effect*
<b>CERVICAL</b>	
C1 to C5	Paralysis of muscles used for breathing and of all arm and leg muscles; usually fatal.
C5 to C6	Legs paralyzed; slight ability to flex arms
C6 to C7	Paralysis of legs and part of wrists and hands; shoulder movement and elbow bending relatively preserved
C8 to T1	Legs and trunk paralyzed; eyelids droop; loss of sweating on the forehead (Horner's syndrome); arms relatively normal; hands paralyzed
<b>THORACIC</b>	
T2 to T4	Legs and trunk paralyzed; loss of feeling below the nipples
T5 to T8	Legs and lower trunk paralyzed; loss of feeling below the rib cage
T9 to T11	Legs paralyzed; loss of feeling below the umbilicus
T12 to L1	Paralysis and loss of feeling below the groin
<b>LUMBAR</b>	
L2 to L5	Different patterns of leg weakness and numbness
S1 to S2	Different patterns of leg weakness and numbness
<b>SACRAL</b>	
S3 to S5	Loss of bladder and bowel control; numbness in the perineum

Nerves run from the spine to specific areas of the body. By noting where a person has weakness, paralysis, or other loss of function (and thus nerve damage), a neurologist can trace back and pinpoint where the spine is damaged.

\*Loss of bladder and bowel control can occur with severe injury anywhere along the spinal column

**The spine** (spinal column) is divided into four areas : cervical (neck), thoracic (chest), lumbar (lower back), and sacral (pelvis). Each area is referred to by a letter (C, T, L, or S). The vertebrae in each area of the spine are numbered beginning at the top. For example, the first vertebra in the cervical spine is labeled C1, the second in the cervical spine is C2, the second in the thoracic spine is T2, the fourth in the lumbar spine is L4, and so forth.

Each of the spinal nerves conveys sensory information from skin areas called **dermatomes** and sends motor impulses to certain muscles. The muscles controlled by a particular spinal nerve are called its **myotome**. To test myotomes, the examiner looks for the patient's ability to make the movement, and if she/he is able to make the movement, assesses the strength of the movement. Examination of the spinal **reflexes** tests the integrity of the sensory and motor components of nerves.

Dermatome	Spinal Level
• Shoulders	C4-C5
• Inner and outer forearms	C6 and T1
• Thumbs and little fingers	C6-C8
• Front of both thighs	L2
• Middle and side of both calves	L4-L5
• Little toes	S1

Deep Tendon Reflex	Spinal Level
• Biceps (upper arm)	C5-C6
• Distal Radius (forearm)	C6-C7
• Triceps (elbow)	C7
• Abdominal	T8-T12
• Quadriceps/Patellar (thigh, knee)	L3-L4
• Ankle	S1

Muscle Activity
0/5 – No movement
1/5 – Trace of muscle contraction
2/5 – Active movement without gravity
3/5 – Active movement against gravity
4/5 – Active movement against gravity/resistance
5/5 – Normal

## The Brain

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

**221.** *The portion of the central nervous system that is enclosed within the cranium, continuous with the spinal cord, and composed of gray matter and white matter. It is the primary center for the regulation and control of bodily activities, receiving and interpreting sensory impulses, and transmitting information to the muscles and body organs. It is also the seat of consciousness, thought, memory, and emotion.* : \_\_\_\_\_

**222.** 1. Something, such as a chair or bench, that may be sat on. 2. The place where something is located or based. A center of something : \_\_\_\_\_

**223.** The faculties by which stimuli from outside or inside the body are received and felt, as the faculties of hearing, sight, smell, touch, taste, and equilibrium. : \_\_\_\_\_

**224.** *The delicate network of branched cells and fibers that supports the tissue of the central nervous system.* : \_\_\_\_\_

**225.** A system of lines or channels that cross or interconnect : \_\_\_\_\_

**226.** Approximately : \_\_\_\_\_

**227.** To direct or control : \_\_\_\_\_

**228.** An unusable or unwanted substance or material : \_\_\_\_\_

**229.** To remove (dirt, impurities, etc.) : \_\_\_\_\_

**230.** Tissue arising chiefly from the embryonic mesoderm that is characterized by a highly vascular matrix and includes collagenous, elastic, and reticular fibers, adipose tissue, cartilage, and bone. It forms the supporting and connecting structures of the body. : \_\_\_\_\_

**231.** *The three membranes that enclose the vertebrate brain and spinal cord: the pia mater, arachnoid, and dura mater.* : \_\_\_\_\_

**232.** *The bony or cartilaginous framework of the head, made up of the bones of the braincase and face; cranium.* : \_\_\_\_\_

**233.** *The tough fibrous membrane covering the brain and the spinal cord and lining the inner surface of the skull. It is the outermost of the three meninges that surround the brain and spinal cord.* : \_\_\_\_\_

**234.** *A delicate membrane that encloses the spinal cord and brain and lies between the pia mater and dura mater.* : \_\_\_\_\_

**235.** *The fine vascular membrane that closely envelops the brain and spinal cord under the arachnoid and the dura mater.* : \_\_\_\_\_

**236.** *A space in the meninges beneath the arachnoid membrane and above the pia mater that contains the cerebrospinal fluid.* : \_\_\_\_\_

**237.** *The serumlike fluid that circulates through the ventricles of the brain, the cavity of the spinal cord, and the subarachnoid space, functioning in shock absorption.* : \_\_\_\_\_

**238.** *A physiological mechanism that alters the permeability of brain capillaries, so that some substances, such as certain drugs, are prevented from entering brain tissue, while other substances are allowed to enter freely.* : \_\_\_\_\_

**239.** *A poisonous substance, especially a protein, that is produced by living cells or organisms and is capable of causing disease when introduced into the body tissues but is often also capable of inducing neutralizing antibodies or antitoxins.* : \_\_\_\_\_

The brain is the seat of intelligence, interpreter of the senses, initiator of body movement, and controller of behavior. It is the most complex part of the human body.

### Histology

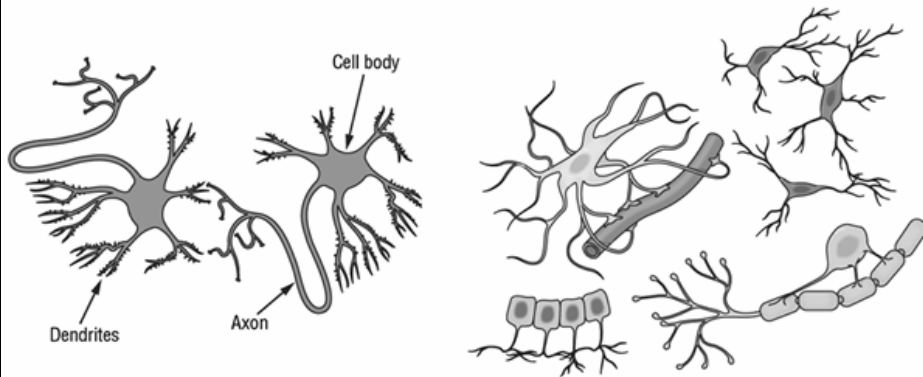
The brain is composed of two broad classes of cells, neurons and glia. Interconnected neurons form neural networks (or neural ensembles). Typically neurons connect to at least a thousand other neurons. These\* highly specialized circuits make up systems which are the basis of perception, different types of action, and higher cognitive function.

In addition to neurons, the brain contains glial cells in a roughly 10 : 1 proportion to neurons. Glial cells create the insulating myelin, provide structure to the neuronal network, manage waste, and clean up neurotransmitters.

Name	Description
<b>Astrocytes</b>	The most abundant type of macroglial cell, astrocytes (also called astroglia) have numerous projections that anchor neurons to their <b>blood supply</b> . They regulate the external chemical environment of neurons by removing excess ions, notably potassium, and recycling <b>neurotransmitters</b> released during synaptic transmission. Astrocytes may regulate vasoconstriction and vasodilation. The current theory suggests that astrocytes are active in the maintenance of the <b>blood-brain barrier</b> . Astrocytes signal each other using calcium. The gap junctions (also known as electrical synapses) between astrocytes allow the messenger molecule IP <sub>3</sub> to diffuse from one astrocyte to another. IP <sub>3</sub> activates calcium channels on cellular organelles, releasing calcium into the cytoplasm. The net effect is a calcium wave that propagates from cell to cell.
<b>Oligodendrocytes</b>	Oligodendrocytes are cells that coat axons in the central nervous system (CNS) with their cell membrane, called myelin, producing the so-called <b>myelin sheath</b> (a role performed by Schwann cells in the peripheral nervous system). The myelin sheath provides insulation to the axon that allows electrical signals to propagate more efficiently.

<b>Ependymal cells</b>	<i>Ependymal cells, also named ependymocytes, line the cavities of the CNS and make up the walls of the ventricles. These cells create and secrete <b>cerebrospinal fluid (CSF)</b> and beat their cilia to help circulate that CSF.</i>
<b>Radial glia</b>	<i>Radial glia cells arise from neuroepithelial cells after the onset of <b>neurogenesis</b>. In the developing nervous system, radial glia function both as neuronal progenitors and as a scaffold upon which newborn neurons migrate. In the mature brain, the cerebellum and retina retain characteristic radial glial cells.</i>

Both neurons and glial cells integrate neural outputs, release transmitters, have long-range signaling, can envelop synaptic terminals, and are connected by gap junction.



#### Typical neurons

Neurons receive stimulation from their branches, known as dendrites. They communicate with other neurons, creating a network with millions of other by firing a nerve impulse along an axon.

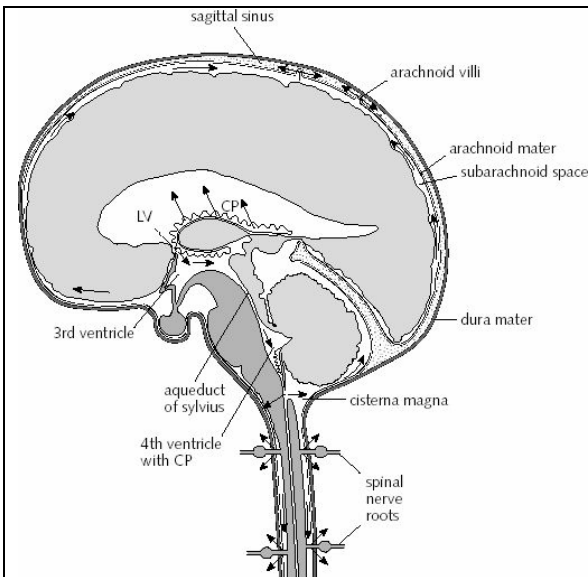
#### Various types of glial cells

Glia carry nutrients, speed repair, provide myelin for axons, support the blood-brain barrier, and may form their own communication network. They are also involved in neurogenesis.

12

The brain is surrounded by connective tissues called the **meninges**, a system of membranes that separate the skull from the brain. This three-layered covering is composed of (from the outside in) the dura mater, arachnoid mater, and pia mater. Below the arachnoid is the subarachnoid space which contains **cerebrospinal fluid (CSF)**, a substance that protects the nervous system. Blood vessels enter the central nervous system through the perivascular space<sup>13</sup> above

the pia mater. The cells in the blood vessel walls are joined tightly, forming the **blood-brain barrier** which protects the brain from toxins that might enter through the blood.



*The brain is bathed in **cerebrospinal fluid (CSF)**, which circulates between layers of the meninges and through cavities in the brain called ventricles. It is important both chemically for metabolism and mechanically for shock-prevention. For example, the human brain weighs about 1-1.5 kg. The mass and density of the brain are such that it will begin to collapse under its own weight if unsupported by the CSF. The CSF allows the brain to float, easing the physical stress caused by the brain's mass.*

**Cerebrospinal fluid (CSF)** – A diagrammatic vertical section through the brain showing the location of the ventricles and the direction of flow of cerebrospinal fluid.<sup>14</sup>

#### What do the following words refer to ?

ss. "These\* highly specialized circuits make up systems" → "These highly specialized circuits" refers to ...

#### True or False ? (Be ready to explain and discuss).

xxiii. About 10% of the cells in the brain are neurons.

xxiv. Albert Einstein's brain contained 73% more glial cells than the average brain.

xxv. The blood-brain barrier, a.k.a. subarachnoid space, is filled with cerebrospinal fluid which protects the brain from toxins, infections and physical shocks.

Questions : (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.

HOW MANY – WHAT (×2)

23. *Number and types of cells in brain tissue Their function.* → ...

two – namely – connect with – to form – and – cells – which – recycle – waste – and

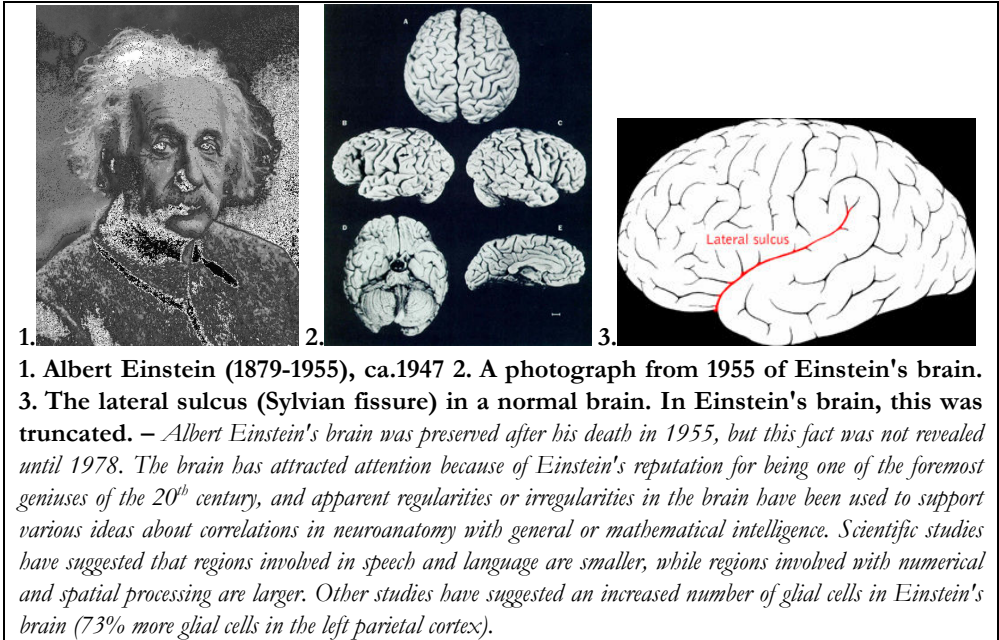
*Brain tissue ...*

24. *Means by which the brain is protected.* → ...

three – known as – which – and contain – fluid – physical – In addition – endothelial – known as – prevents – harmful – entering

*The brain is protected...*

25. Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.



# Brain anatomy

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

**240.** The portion of the brain, consisting of the medulla oblongata, pons Varolii, and midbrain, that connects the spinal cord to the forebrain and cerebrum. : \_\_\_\_\_

**241.** The trilobed structure of the brain, lying posterior to the pons and medulla oblongata and inferior to the occipital lobes of the cerebral hemispheres, that is responsible for the regulation and coordination of complex voluntary muscular movement as well as the maintenance of posture and balance. : \_\_\_\_\_

**242.** 1. A memorizing process using routine or repetition, often without full attention or comprehension: learn by rote. 2. Mechanical routine. : \_\_\_\_\_

**243.** The large rounded structure of the brain occupying most of the cranial cavity, divided into two cerebral hemispheres that are joined at the bottom by the corpus callosum. It controls and integrates motor, sensory, and higher mental functions, such as thought, reason, emotion, and memory. : \_\_\_\_\_

**244.** To cover with a layer : \_\_\_\_\_

**245.** 1. The outer layer of an organ or body part, such as the cerebrum or the adrenal glands. 2. The convoluted layer of gray substance covering each cerebral hemisphere : \_\_\_\_\_

**246.** The sciences concerned with gathering, manipulating, storing, retrieving, and classifying recorded information : \_\_\_\_\_

**247.** To be without, To be missing or deficient : lack / \_\_\_\_\_

**248.** A crease or ridge, as of a membrane : \_\_\_\_\_

**249.** The extent of a 2-dimensional surface : \_\_\_\_\_

**250.** Gray areas of brain and spinal cord made up primarily of cell bodies and dendrites of nerve cells rather than myelinated axons. : \_\_\_\_\_

**251.** An area or a point equidistant between extremes; a center : \_\_\_\_\_

**252.** 1. A half of a sphere. 2. Either of the lateral halves of the cerebrum : \_\_\_\_\_

**253.** The faculty or act of speaking. The faculty or act of expressing or describing thoughts, feelings, or perceptions by the articulation of words. : \_\_\_\_\_

**254.** How some object is located in space in relation to some reference object : \_\_\_\_\_

**255.** Located directly across from something else or from each other : \_\_\_\_\_

**256.** To cause harm or injury, to injure : \_\_\_\_\_

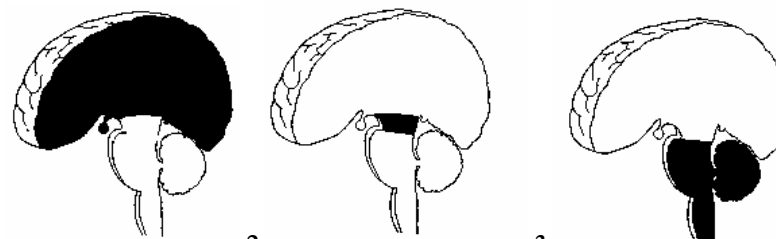
**257.** A sudden loss of brain function caused by a blockage or rupture of a blood vessel to the brain, resulting in necrosis of brain tissue and characterized by loss of muscular control, diminution or loss of sensation or consciousness, dizziness, slurred speech, or other symptoms that vary with the extent and severity of brain damage. Also called cerebral accident, cerebral infarction, cerebrovascular accident. : \_\_\_\_\_

**258.** Extending far downward below a surface : \_\_\_\_\_

**259.** The arched bridge of nervous tissue that connects the two cerebral hemispheres, allowing communication between the right and left sides of the brain. : \_\_\_\_\_

**260.** Relatively great in extent from one surface to the opposite, usually in the smallest solid dimension; not thin : \_\_\_\_\_

**261.** A cluster or strand of closely bound muscle or nerve fibers : \_\_\_\_\_



1. The Forebrain, 2. The Midbrain, 3. The Hindbrain – The brain can be divided into three basic units : the forebrain (cerebrum, thalamus and hypothalamus), the midbrain (which is involved in some reflex actions and eye movements), and the hindbrain (which controls the body's vital functions such as respiration and heart rate, and includes the brainstem and cerebellum).<sup>15</sup>

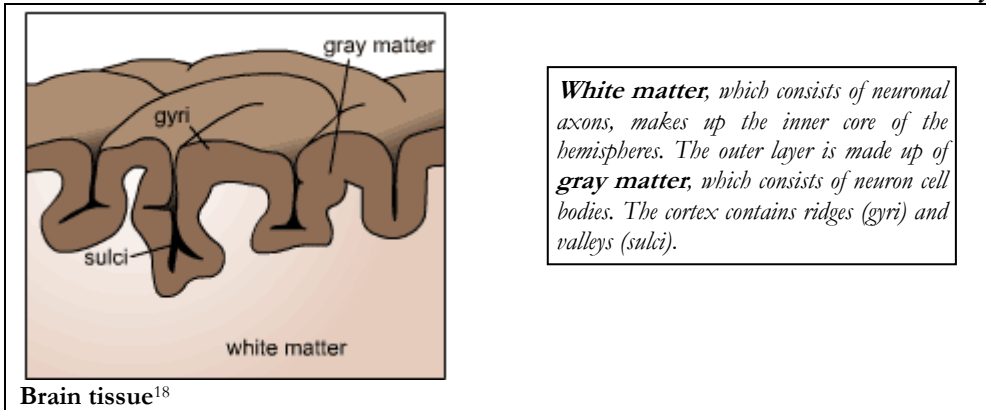
At the base of the brain, the **brainstem**<sup>16</sup> is structurally continuous with the spinal cord. All information relayed from the body to the brain and vice versa must pass through the brainstem<sup>17</sup>. The **cerebellum** (which, like the brainstem, is anatomically part of the hindbrain) coordinates movement and is involved in learned rote movements, such as playing the piano or hitting a tennis ball. The largest and most well-developed part of the brain, the **cerebrum**, sits on top of the brainstem and is the source of intellectual activities, including thought, reason, emotion, and memory.

Coating\* the surface of the cerebrum and the cerebellum is a vital layer of tissue called the **cortex**. Most of the actual information processing in the brain takes place in the cerebral cortex. The cortex is gray because nerves in this\* area lack the insulation (myelination) that makes most other parts of the brain appear to be white. The folds in the cortex add to its\* surface area and therefore increase the amount of gray matter and the quantity of information that can be processed.

<sup>15</sup> [http://www.ninds.nih.gov/disorders/brain\\_basics/know\\_your\\_brain.htm](http://www.ninds.nih.gov/disorders/brain_basics/know_your_brain.htm)

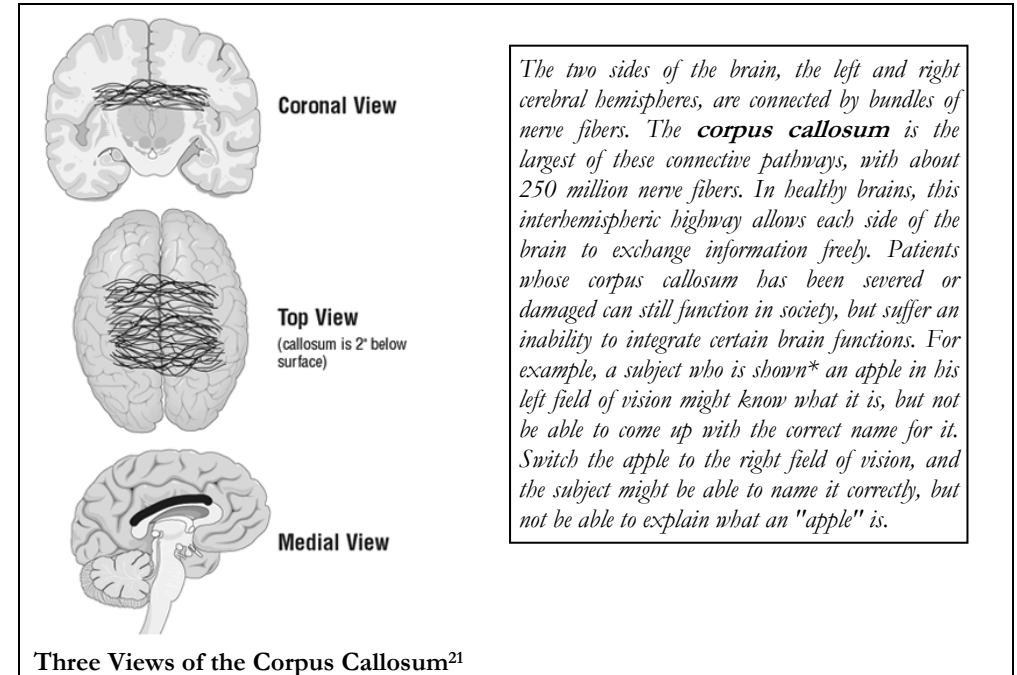
<sup>16</sup> <http://www.britannica.com/EBchecked/topic/77391/brainstem>

<sup>17</sup> <http://en.wikipedia.org/wiki/Brainstem#Functions>



**White matter**, which consists of neuronal axons, makes up the inner core of the hemispheres. The outer layer is made up of **gray matter**, which consists of neuron cell bodies. The cortex contains ridges (gyri) and valleys (sulci).

The cerebral cortex is divided down the middle, from front to back, into **hemispheres**, or halves. Each hemisphere has different functions. The left side of the cerebral cortex controls the right side of the body and speech. The right side controls the left side of the body and the perception of spatial relationships. Indeed, sensory and motor nerve fibers connecting the brain and the rest of the body cross over to the opposite side as they pass through the lowermost part of the brainstem, or "medulla oblongata"<sup>19</sup>. Thus, each hemisphere of the brain (cerebrum<sup>20</sup>) communicates with the opposite side of the body, and when one side of the brain is damaged, the opposite side of the body is affected. For example, a stroke in the right hemisphere of the brain can leave the left arm and leg paralyzed. The hemispheres are connected deep in the brain by the **corpus callosum**, a thick bundle of nerve fibers through which information is passed between the left and right hemispheres of the brain.



The two sides of the brain, the left and right cerebral hemispheres, are connected by bundles of nerve fibers. The **corpus callosum** is the largest of these connective pathways, with about 250 million nerve fibers. In healthy brains, this interhemispheric highway allows each side of the brain to exchange information freely. Patients whose corpus callosum has been severed or damaged can still function in society, but suffer an inability to integrate certain brain functions. For example, a subject who is shown\* an apple in his left field of vision might know what it is, but not be able to come up with the correct name for it. Switch the apple to the right field of vision, and the subject might be able to name it correctly, but not be able to explain what an "apple" is.

#### What do the following words refer to ?

- tt. "it\* consists primarily of the cerebrum" → "It" refers to ...  
 uu. "Coating\* the surface of the cerebrum and the cerebellum" → The subject of "coating" is ...  
 vv. "nerves in this\* area lack the insulation (myelination)" → "This area" refers to ...  
 ww. "add to its\* surface area" → "Its" refers to ...

#### True or False ? (Be ready to explain and discuss).

- xxvi. Split-brain patients (whose corpus callosum has been cut or damaged) can say the name of an object in their left visual field, but cannot pick it up with their left hand.

<sup>21</sup> [http://www.ascd.org/publications/books/104013/chapters/Meet\\_Your\\_Amazing\\_Brain.aspx](http://www.ascd.org/publications/books/104013/chapters/Meet_Your_Amazing_Brain.aspx)

\*NB. "a subject who is shown an apple in his left field of vision ..." ⇒ un sujet à qui on montre une pomme... – Il existe en anglais deux formes passives pour les verbes à double complément (p.ex. "donner qqch à qqn", "montrer qqch à qqn", "envoyer qqch à qqn"). Ainsi, à partir de la phrase "John gave Susan a book" on peut choisir, 1/ soit la chose qu'on a donnée/montrée etc. : *A book was given to Susan (by John)* comme en français, 2/ soit la personne à qui on a donné/montré qqch : *Susan was given a book (by John)*. Cette deuxième construction n'existe pas sous cette forme en français.

<sup>18</sup> <http://www.stanford.edu/group/hopes/basics/brainut/ab3.html>

<sup>19</sup> Encarta Encyclopedia, "Medulla Oblongata"

<sup>20</sup> Unlike the cerebrum, the left cerebellum controls the left side of the body, and the right cerebellum controls the right side of the body. (cf. [www.princetonbrainandspine.com/subject.php?pn=brain-anatomy-066](http://www.princetonbrainandspine.com/subject.php?pn=brain-anatomy-066))



xxvii. *In left-handed people, speech is controlled by the right side of the brain.*

**Questions :** (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.

WHAT (×4) – WHERE – HOW

26. **Gray matter :** *its composition and its location in the brain. The function of the cerebral cortex. "Sulci".* → ...

unmyelinated – (or parts – without – such as –) – mainly – cerebral – where – processing – and also – cerebellar – folds – increase – and consequently – information

*Gray matter ...*

27. **The meaning of "lateralization".** *The means by which communication takes place between the two hemispheres.* → ...

each – opposite – and specializes – Thus, – right – vision – hemisphere – and – stroke – paralysis – side – bundle – known as – possible – to pass – between

*Lateralization ...*

28. **Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.**

# The Geography of Thought

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

262. A subdivision of a bodily organ or part bounded by fissures, connective tissue, or other structural boundaries. : \_\_\_\_\_

263. To formulate a scheme or program : \_\_\_\_\_

264. 1. A list of times; a timetable. 2. A plan for performing work or achieving an objective : \_\_\_\_\_

265. The largest and forwardmost lobe of each cerebral hemisphere, responsible for the control of skilled motor activity, including speech. : \_\_\_\_\_

266. Involving or lasting a relatively brief time : \_\_\_\_\_

267. The process of reserving something for future use : \_\_\_\_\_

268. To remember a piece of information : \_\_\_\_\_

269. Farthest in the rear; last : \_\_\_\_\_

270. The region of the cerebral cortex influencing movements of the face, neck and trunk, and arm and leg. : \_\_\_\_\_

271. Arising from one's own free will. : \_\_\_\_\_

272. Located a short distance away; close : \_\_\_\_\_

273. A small posterior part of the inferior frontal gyrus of the left cerebral hemisphere, identified as an essential component of the motor mechanisms governing articulated speech. : \_\_\_\_\_

274. 1. The act or process of thinking; cogitation. 2 A product of thinking. Syn. idea. : \_\_\_\_\_

275. The food served and eaten at one time : \_\_\_\_\_

276. The upper middle lobe of each cerebral hemisphere, located above the temporal lobe. Complex sensory information from the body is processed in this area, which also controls the ability to understand language. : \_\_\_\_\_

277. The act of examining and understanding the meaning of written or printed characters, words, or sentences : \_\_\_\_\_

278. The mathematics of integers, rational numbers, real numbers, or complex numbers under addition, subtraction, multiplication, and division. : \_\_\_\_\_

279. The posterior lobe of each cerebral hemisphere, having the shape of a three-sided pyramid and containing the visual center of the brain. : \_\_\_\_\_

280. To prepare, treat, or convert by subjecting to a special process. To gain an understanding of something : \_\_\_\_\_

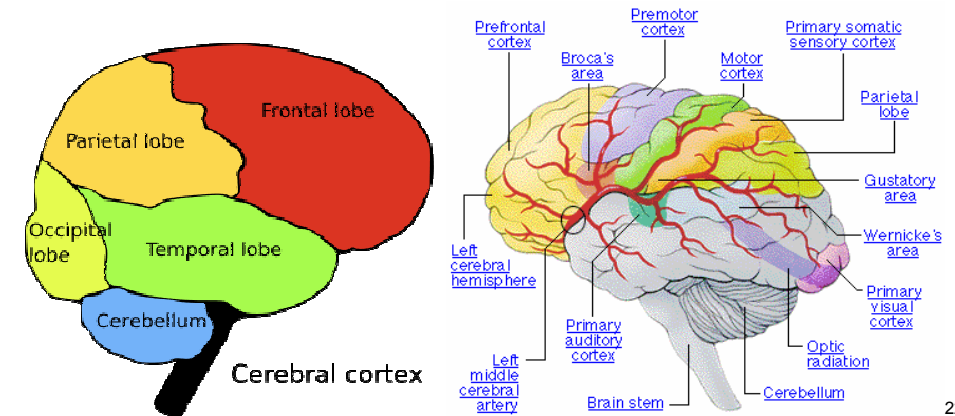
281. To connect with something : \_\_\_\_\_

282. The faculty by which sensations, impressions, and ideas are stored and recalled. The mental faculty of retaining and recalling past experience based on the mental processes of learning, retention, recall, and recognition. : \_\_\_\_\_

283. Lack or loss of ability to see; lack of perception of visual stimuli. : \_\_\_\_\_

284. The lower lateral lobe of either cerebral hemisphere, located in front of the occipital lobe and containing the sensory center of hearing in the brain. : \_\_\_\_\_

285. The act of remembering; recollection. Something remembered. : \_\_\_\_\_



22

Each cerebral hemisphere can be divided into sections, or lobes, each of which\* specializes in different functions. Whenever one plans a schedule, imagines the future, or uses reasoned arguments, the two frontal lobes act as short-term storage sites, allowing one idea to be kept in mind while other ideas are considered. In the rearmost portion of each frontal lobe is a motor area, which helps control voluntary movement. A nearby\* place on the left frontal lobe called Broca's area allows thoughts to be transformed into words.

When a person enjoys a good meal two sections behind the frontal lobes called the parietal lobes are at work. These\* areas receive information about temperature, taste, touch, and movement from the rest of the body. Reading and arithmetic are also functions in the repertoire of each parietal lobe. The occipital lobes, at the back of the brain, process images from the eyes and link that\* information with images stored in memory. Damage to the occipital lobes can cause blindness. At the top of each temporal lobe is an area responsible for receiving information from the ears. Other parts of this\* lobe seem to integrate memories and sensations of taste, sound, sight, and touch.

**What do the following words refer to ?**

xx. "each of which\* specializes in different functions" → "Which" refers to ...

yy. "A nearby\* place on the left frontal lobe" → Broca's area is near to...

<sup>22</sup> www.medem.com/medlb/article\_detailb.cfm?article\_ID=ZZZ0ZFP46JC&sub\_cat=189

zz. "These\* areas receive information about temperature, taste, touch..." → "These areas" refers to...

aaa. "and link that\* information" → "That information" refers to ...

bbb. "Other parts of this\* lobe" → "This lobe" refers to ...

**True or False ? (Be ready to explain and discuss).**

xxviii. *The cerebral cortex can be divided into 5 lobes : the frontal, parietal, occipital, temporal and cerebellum.*

xxix. *The motor area is located on the right side in left-handed people, and on the left side in right-handed people.*

**Questions :** (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.

WHICH

**29. Areas of the brain specialized in abstract thought and/or sensory perception. →**

...

future – or – arguments – lobe – which – temporary – ideas – whereas – sensory – organized into – by – lobe – (which – and touch) – and – sight – as well as – sounds

*Abstract thought, such as ...*

**30. Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.**

**VOCABULARY in context.** Match the following definitions with words from the reading passage below, then give an appropriate translation in French.

286. To cause physical harm to; hurt. : \_\_\_\_\_
287. The rhythmical throbbing of arteries produced by the regular contractions of the heart, especially as palpated at the wrist or in the neck. : \_\_\_\_\_
288. To reduce or weaken in strength, quality, etc : \_\_\_\_\_
289. The act or an instance of losing something : \_\_\_\_\_
290. The part of the arm between the wrist and the elbow. : \_\_\_\_\_
291. To seek treatment, to consult a doctor for a symptom : \_\_\_\_\_
292. Small in size, degree, or amount : \_\_\_\_\_
293. Constant but not intense : \_\_\_\_\_
294. An unpleasant, typically physical sensation occurring in varying degrees of severity as a consequence of injury, disease, or emotional disorder. : \_\_\_\_\_
295. A method of obtaining an X-ray of blood vessels by injecting into them a substance, such as one containing iodine, that shows up as opaque on an X-ray picture : \_\_\_\_\_
296. The use of nuclear magnetic resonance to produce images of the molecules that make up a substance, especially the soft tissues of the human body, used in medicine to diagnose disorders of body structures that do not show up well on x-rays. : \_\_\_\_\_
297. The abnormal buildup (accumulation) of blood in an organ or other tissue of the body, caused by a break in a blood vessel. : \_\_\_\_\_
298. A general term for the results of an intervention or process. The condition of a patient at the end of therapy or a disease : \_\_\_\_\_
299. One of the jointed appendages, such as an arm or a leg : \_\_\_\_\_
300. A person or group having administrative or managerial authority in an organization. : \_\_\_\_\_
301. A common disorder in which blood pressure remains abnormally high (140/90 mm Hg or greater) : \_\_\_\_\_
302. To fall down suddenly : \_\_\_\_\_
303. Due to decrease in the blood supply to a bodily organ, tissue, or part caused by constriction or obstruction of the blood vessels. : \_\_\_\_\_
304. The act of asking. : \_\_\_\_\_

## Case History<sup>23</sup> 1

A 16-year-old male, "Mike", injured his right shoulder in a motorbike accident. On initial physical evaluation, the pulses on the radial and ulnar arteries in the

<sup>23</sup> <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2329636/> Axillary artery injury combined with delayed brachial plexus palsy due to compressive hematoma in a young patient: a case report

affected arm were palpable. Paralysis developed 2 days after the injury. Functions in the right arm became significantly impaired.

On physical examination, the pulses of the radial and ulnar arteries of the right arm were significantly diminished compared to those in the left arm. Blood pressure was 42/20 mm Hg in the right arm, and 122/70 mm Hg in the left arm.

On neurological examination, muscle power in the right arm and hand included<sup>24</sup> :

- |                        |   |
|------------------------|---|
| • brachialis (0)       | • flexor digitorum profundus/sublimis (4) |
| • biceps (0)           | • flexor pollicis longus (4)              |
| • triceps (0)          | • extensor digitorum communis (0)         |
| • pectoralis major (3) | • extensor pollicis longus (0)            |

The patient could elevate the upper arm 120° against gravity, indicating that the suprascapular nerve was intact.

Complete sensory loss was observed in the lateral aspect of the upper arm and dorsoradial aspects of the forearm and hand. The patient complained of dull pain at the radial aspect of the forearm.

Angiography showed complete occlusion of the axillary artery. MRI demonstrated a mass measuring 4 × 5 cm that was suspected to be a hematoma compressing the brachial plexus. Surgery was performed on the third day after injury.

Following evacuation of the hematoma, the brachial plexus was explored macroscopically and was found to be intact.

## Outcome :

After evacuation of the hematoma, and revascularization of the axillary artery, the patient had an excellent functional recovery of the affected upper limb postoperatively.

<sup>24</sup> NB. 0 to 5 rating scale for muscle strength :

- 0/5 : No movement
- 1/5 : Slight movement of the muscle, though not enough to move the structure
- 2/5 : Voluntary movement which is not sufficient to overcome the force of gravity. For example, the patient is able to slide his/her hand across a table but not lift it from the surface.
- 3/5 : Voluntary movement capable of overcoming gravity, but no applied resistance. For example, the patient could raise their hand off a table, but not if any additional resistance were applied.
- 4/5 : Voluntary movement capable of overcoming "some" resistance
- 5/5 : Normal strength

## Case History 2<sup>25</sup>

A 61-year-old business executive, "Howard", with a long history of high blood pressure collapsed while jogging over the lunch hour. His jogging mate quickly contacted a police officer who helped carry the man to a hospital just down the road. At the hospital, an MRI was performed that revealed a blockage of a major cerebral artery (the left anterior cerebral artery) and ischemic changes to the portion of the brain supplied by that artery, i.e. the medial portions of his left frontal and parietal lobes. With quick medical attention, the man was stabilized, and he slowly improved over the next three weeks. The following signs and symptoms did persist, however :

- paralysis of the right leg and foot
- loss of sensation on the skin of the right leg and foot
- inability to identify a tennis ball placed in the left hand, but ability to name it if placed in the right hand
- inability to follow a request to throw the tennis ball with his left hand, but ability to throw it with his right hand

True or False ? (Be ready to explain and discuss).

xxx. Howard's Broca's area has been damaged in his stroke.

Questions : (1) Ask questions about the following points, then (2) let someone else answer in a complete sentence (3) using as many of the suggested terms as possible.

WHAT (×2) – HOW – WHY (×2)

31. *Signs and symptoms of nerve injury following Mike's accident. The extent of Mike's recovery, and the reasons for this.* → ...

developed – several – including – as well as – sensory – due to – and – compressing –  
Fortunately – because – intact

Following his accident ...

32. *The reason* the patient cannot identify the ball when it is placed in his left hand.  
→ ...

ball – left – because – connected to – side – whereas – language – suffered – damage –  
information – right side – language areas

The patient cannot ...

33. *Indications from* the fact that the patient can follow verbal instructions with his right hand, but not with his left hand. → ...

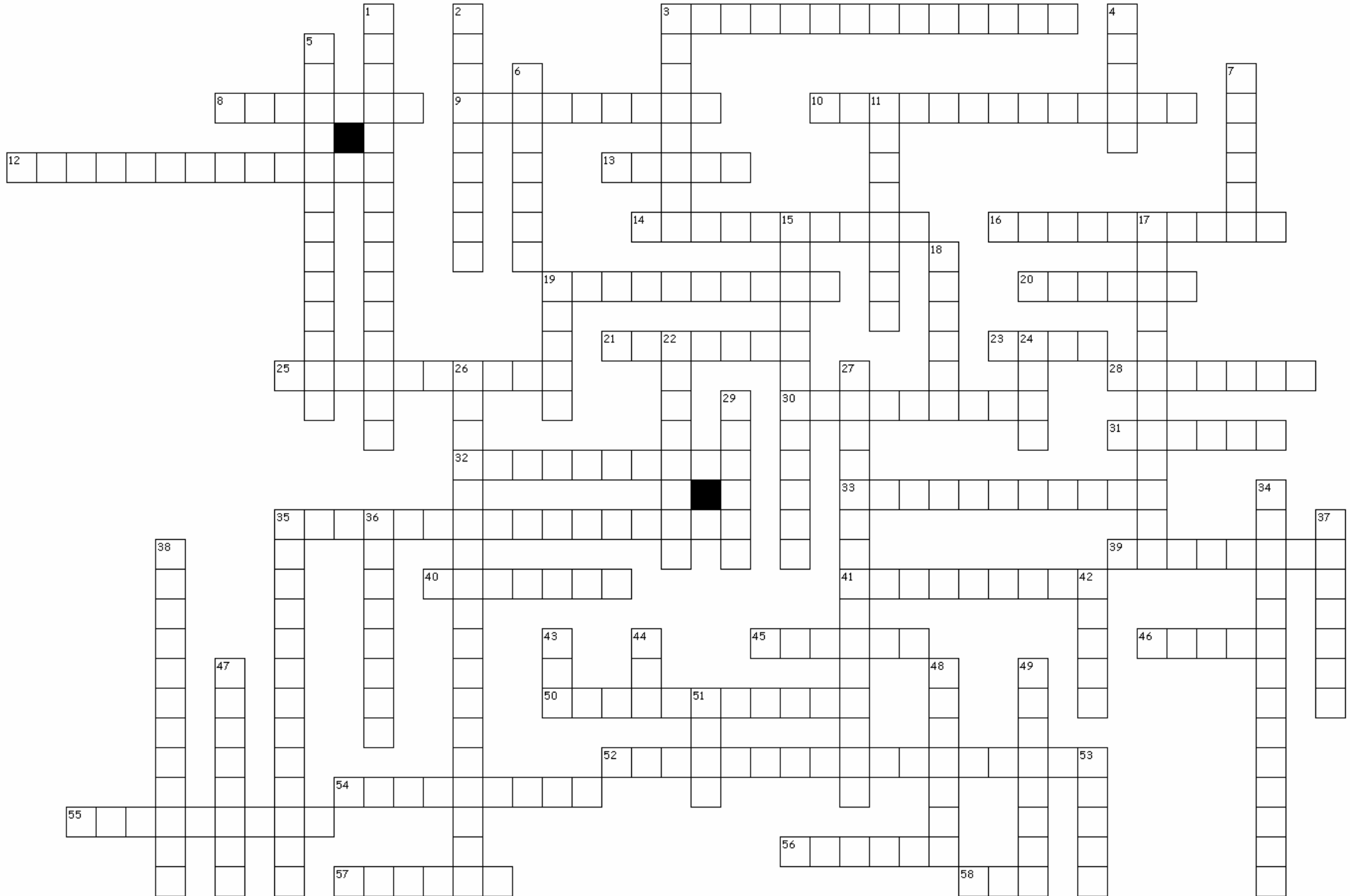
confirmation – understands – and – right hand – but – right hemisphere

...

34. Make up one original question of your own relating to this section of the article, and write a 2-3 line answer to it using information either from the article or from outside sources.

<sup>25</sup> [http://www.mhhe.com/biosci/ap/ap\\_casestudies/index.html](http://www.mhhe.com/biosci/ap/ap_casestudies/index.html)

*The Nervous System L3/DCEM1 2012*



## *The Nervous System L3/DCEMI 2012*

### **Across**

3. Loss of the difference in charge between the inside and outside of the plasma membrane of a muscle or nerve cell due to a change in permeability and migration of sodium ions to the interior.
8. A sensory and motor nerve originating in the sacral plexus and running through the pelvis and upper leg.
9. A conductor through which an electric current enters or leaves a substance electrical characteristics are being measured, used, or manipulated.
10. A chemical,  $C_7H_{17}NO_3$ , that is released at autonomic synapses and neuromuscular junctions in the somatic and parasympathetic nervous systems and is involved in the transmission of nerve impulses in the body.
12. The amount of a specified substance in a unit amount of another substance. The relative content of a component (as dissolved or dispersed material) of a solution, mixture, or dispersion that may be expressed in percentage by weight or by volume, in parts per million, or in grams per liter.
13. The portion of the human leg between the hip and the knee and supported by a single large bone (the femur).
14. 1. A half of a sphere. 2. Either of the lateral halves of the cerebrum.
16. A small posterior part of the inferior frontal gyrus of the left cerebral hemisphere, identified as an essential component of the motor mechanisms governing articulated speech.
19. The thick, whitish cord of nerve tissue that extends from the medulla oblongata down through the spinal column and from which the spinal nerves branch off to various parts of the body.
20. The impulse-conducting cells that constitute the brain, spinal column, and nerves, consisting of a nucleated cell body with one or more dendrites and a single axon.
21. A substance, usually a peptide or steroid, produced by one tissue and conveyed by the bloodstream to another to effect physiological activity, such as growth or metabolism
23. The delicate network of branched cells and fibers that supports the tissue of the central nervous system.
25. The nerves outside the central nervous system including the cranial nerves (excepting the optic nerve), the spinal nerves, and the sympathetic and parasympathetic nervous systems.
28. 1. A tubular passage for liquids, etc. 2. A pathway through a protein molecule in a cell membrane that modulates the electrical potential across the membrane by controlling the passage of small inorganic ions into and out of the cell.
30. The portion of the brain, consisting of the medulla oblongata, pons Varolii, and midbrain, that connects the spinal cord to the forebrain and cerebrum.
31. 1. A dark resinous extract obtained from several tropical American woody plants, especially *Chondrodendron tomentosum* or certain species of *Strychnos*, used as an arrow poison by some Indian peoples of South America.  
2. A purified preparation or alkaloid obtained from *Chondrodendron tomentosum*, used in medicine and surgery to relax skeletal muscles.
32. The trilobed structure of the brain, lying posterior to the pons and medulla oblongata and inferior to the occipital lobes of the cerebral hemispheres, that is responsible for the regulation and coordination of complex voluntary muscular movement as well as the maintenance of posture and balance.
33. The part of the autonomic nervous system that is concerned especially with preparing the body to react to situations of stress or emergency, that contains adrenergic fibers and tends to depress secretion, decrease the tone and contractility of smooth muscle, increase heart rate.
35. A chemical substance, such as norepinephrine, acetylcholine or dopamine, that transmits nerve impulses across a synapse.
39. The large rounded structure of the brain occupying most of the cranial cavity, divided into two cerebral hemispheres that are joined at the bottom by the corpus callosum. It controls and integrates motor, sensory, and higher mental functions, such as thought, reason, emotion, and memory.
40. To decrease, limit, or block the action or function of (an enzyme or organ, for example).
41. Impairment or loss of voluntary muscle function or of sensation in a part or area of the body, usually caused by a lesion or disorder of the muscles or the nerves supplying them.
45. 1. The outer layer of an organ or body part, such as the cerebrum or the adrenal glands. 2. The convoluted layer of gray substance covering each cerebral hemisphere.
46. The tenth and longest of the cranial nerves, passing through the neck and thorax into the abdomen and supplying sensation to part of the ear, the tongue, the larynx, and the pharynx, motor impulses to the vocal cords, and motor and secretory impulses to the abdominal and thoracic viscera.
50. The largest and forwardmost lobe of each cerebral hemisphere, responsible for the control of skilled motor activity, including speech.
52. A physiological mechanism that alters the permeability of brain capillaries, so that some substances, such as certain drugs, are prevented from entering brain tissue, while other substances are allowed to enter freely.
54. Capable of responding to sensory stimuli; awake, alert; aware of one's external environment.
55. The part of the nervous system that regulates involuntary action, as of the intestines, heart, and glands, and that is divided into the sympathetic nervous system and the parasympathetic nervous system.
56. Exceptionally small; tiny.
57. To transport. To serve as a medium of transmission; transmit. To communicate.
58. The part of the nervous system which consists of the brain and spinal cord, to which sensory impulses are transmitted and from which motor impulses pass out, and which supervises and coordinates the activity of the entire nervous system.



**Down**

1. *A localized change in electrical potential, from about -70 mV to +30 mV and back again, that occurs across a nerve fibre during transmission of a nerve impulse.*
2. *A person having expert knowledge of one or more sciences, especially a natural or physical science.*
3. *A branched protoplasmic extension of a nerve cell that conducts impulses from adjacent cells inward toward the cell body.*
4. *The portion of the central nervous system that is enclosed within the cranium, composed of gray matter and white matter. It is the primary center for the regulation and control of bodily activities, receiving and interpreting sensory impulses, and transmitting information to the muscles and body organs.*
5. *Several nerves that arise in pairs from the brainstem and reach the periphery through openings in the skull. There are 12 such pairs in humans.*
6. *Transmitting impulses from sense organs to nerve centers; afferent.*
7. *A sudden loss of brain function caused by a blockage or rupture of a blood vessel to the brain, resulting in necrosis of brain tissue and characterized by loss of muscular control, diminution or loss of sensation or consciousness, dizziness, slurred speech, or other symptoms that vary with the extent and severity of brain damage.*
11. *Carrying impulses from the central nervous system to the periphery of the body.*
15. *The property of having pores or openings that permit liquids or gases to pass through.*
17. *Muscle tissue that contracts without conscious control, having the form of thin layers or sheets made up of spindle-shaped, unstriated cells with single nuclei and found in the walls of the internal organs, such as the stomach, intestine, bladder, and blood vessels, excluding the heart.*
18. *A structure in the form of a network, especially of nerves, blood vessels, or lymphatics.*
19. *The bony or cartilaginous framework of the head, made up of the bones of the braincase and face; cranium.*
22. *To adjust (a mechanism) for accurate and proper functioning.*
24. *One of the jointed appendages, such as an arm or a leg, used for locomotion etc.*
26. *A class of microscopes that use electrons rather than visible light to produce magnified images, especially of objects having dimensions smaller than the wavelengths of visible light, with linear magnification approaching or exceeding a million (10<sup>6</sup>).*
27. *The part of the autonomic nervous system originating in the brain stem and the lower part of the spinal cord that, in general, tends to stimulate digestive secretions, slow the heart, constrict the pupils, and dilate blood vessels.*
29. *The act of remembering; recollection. Something remembered.*
34. *The arched bridge of nervous tissue that connects the two cerebral hemispheres, allowing communication between the right and left sides of the brain.*
35. *A substance C<sub>8</sub>H<sub>11</sub>NO<sub>3</sub>, both a hormone and neurotransmitter, secreted by the adrenal medulla and the nerve endings of the sympathetic nervous system to cause vasoconstriction and increases in heart rate, blood pressure, and the sugar level of the blood. It is the chemical means of transmission across synapses in postganglionic neurons of the sympathetic nervous system and in some parts of the central nervous system.*
36. *A molecular structure or site on the surface or interior of a cell that binds with substances such as hormones, antigens, drugs, or neurotransmitters.*
37. *The electrochemical transmission of a signal along a nerve fiber that produces an excitatory or inhibitory response at a target tissue, such as a muscle or another nerve.*
38. *A space in the meninges beneath the arachnoid membrane and above the pia mater that contains the cerebrospinal fluid.*
42. *Various marine cephalopod mollusks of the genus *Loligo* and related genera, having a usually elongated body, ten arms surrounding the mouth, a vestigial internal shell, and a pair of triangular or rounded fins.*
43. *The serumlike fluid that circulates through the ventricles of the brain, the cavity of the spinal cord, and the subarachnoid space, functioning in shock absorption.*
44. *An atom or a group of atoms that has acquired a net electric charge by gaining or losing one or more electrons.*
47. *The portion of a nerve cell that contains the nucleus but does not incorporate the dendrites or axon. Also called soma.*
48. *The junction across which a nerve impulse passes from an axon terminal to a neuron, muscle cell, or gland cell.*
49. *The three membranes that enclose the vertebrate brain and spinal cord: the pia mater, arachnoid, and dura mater.*
51. *The usually long process of a nerve fiber that generally conducts impulses away from the body of the nerve cell.*
53. *Relation in degree or number between two similar things.*

## The Nervous System L3/DCEMI 2012

• (action) potential / le potentiel d'action, l'influx nerveux	• brainstem / le tronc cérébral	• conducting / conducteur	• executive / un cadre (dans une entreprise)	• information processing / le traitement des données	• memory / la mémoire
• (neuro)transmitter / un neurotransmetteur, neuromédiateur	• branch / se ramifier	• connective tissue / le tissu conjonctif	• exert (on) / exercer (sur)	• inhibit / inhiber, enrayer, bloquer	• memory / un souvenir
• acetylcholine / l'acétylcholine (f.)	• break / une interruption	• conscious / conscient	• extracellular / extracellulaire	• inhibitory / inhibiteur	• meninges (sing. meninx) / les méninges (f.pl.)
• act as / servir de, agir comme, en	• breathing / la respiration	• control / diriger, régler	• eyeball / le globe oculaire	• initiate / déclencher	• micropipette / une micropipette
• action potential / le potentiel d'action	• Broca's area / l'aire de Broca	• convey / transmettre	• fibre / une fibre	• injure / blesser	• middle / le milieu, le centre
• advent / l'arrivée, l'apparition de	• bundle / un faisceau	• cord / un cordon	• fight or flight / la réaction de "lutte ou de fuite"	• intercostal muscles / les muscles intercostaux	• millisecond (msec) / une milliseconde, un millième de seconde
• along / le long de	• bundle / un faisceau	• corpus callosum / le corps calleux	• fold / un pli	• internuncial / (neurone) intercalaire, interneurone	• mind / l'esprit
• alter / modifier, changer	• cardiac muscle / le muscle cardiaque	• cortex / le cortex (cérébral)	• foot / le pied	• investigations (into) / des recherches sur	• minute / minuscule, infime
• among / parmi	• cell body / le corps cellulaire (aussi : le cytoplasme), le soma (d'un neurone), le péricaryon	• course / le cours, le parcours	• forearm / l'avant-bras	• ion / un ion	• modify / modifier
• and so on / et ainsi de suite	• cell membrane / la membrane cellulaire	• cranial nerves / les nerfs crâniens	• freely / librement, en arborescence	• ischemic / ischémique	• motor (nerve) / un nerf moteur
• angiography / l'angiographie	• cross / traverser	• curare / le curare	• frontal lobe / le lobe frontal	• keep in mind / garder (présent) à l'esprit	• motor area (motor cortex) / l'aire motrice, le cortex moteur
• anterior / antérieur	• damage / endommager	• deep / profond	• further / (de) plus, davantage	• larynx / le larynx	• motor neuron / un motoneurone
• apply to / appliquer à (sur)	• dendrite / une dendrite	• depolarization / la dépolarisation	• gap / 1. une brèche, un interstice ; 2. un intervalle	• lead to / conduire à, mener à	• MRI (magnetic resonance imaging) / l'IRM
• arachnoid (mater) / l'arachnoïde (f.)	• destroy / détruire	• detect / détecter	• gastro-intestinal (GI) tract / le tube digestif, l'appareil gastro-intestinal	• leg / la jambe	• muscle / le muscle
• area / 1. une zone, une région 2. un domaine	• cerebellum / le cervelet	• discovery / une découverte	• gate (ligand-gated, voltage-gated) / un "portal", le mécanisme d'ouverture (chimio-dépendant, tensiodépendant)	• length / la longueur	• nearby / proche, à proximité, avoisinant
• arise / 1. survenir, 2. provenir de	• cerebrospinal fluid / liquide céphalo-rachidien (ou LCR), liquide cérébro-spinal (LCS)	• distinguish from / distinguer de	• give off / émettre, former, faire naître	• limb / un membre	• nerve fibre / une fibre nerveuse
• arise from / provenir de, procéder de	• cervical / cervical	• divert / dévier, détourner, rediriger	• give rise to / donner lieu à, entraîner	• limb / un membre (supérieur, inférieur)	• nerve impulse / un influx nerveux
• arithmetic / l'arithmétique (f.)	• cervical nerves / les nerfs cervicaux	• divide into / se diviser en, se partager en, se répartir	• gland / une glande	• lining / un revêtement intérieur	• nervous system / le système nerveux
• arousal / l'excitation	• channel (ion channel) / un canal (ionique)	• dramatically / de façon spectaculaire	• glia, (neuro)glia / la glie, la (névro)glie	• link / lier, relier	• network / un réseau
• artificially / artificiellement	• charged (electrically) / chargé, porteur d'une charge électrique— NS	• drug / un médicament, une drogue	• gray (grey) matter / la matière grise	• link / un lien	• network / un réseau (nerveux)
• at rest / au (en) repos, inactif	• chemical / une substance (chimique)	• dull (pain) / sourd, vague (douleur)	• heart / le cœur	• lobe / un lobe	• neuromuscular junction / une synapse (jonction?) neuromusculaire
• atrioventricular node / le noeud atrio-ventriculaire (auriculo-ventriculaire)	• chemical stability / la stabilité chimique, l'équilibre (m.)	• dura mater / la dure-mère	• heart rate / la fréquence cardiaque, le rythme cardiaque	• loss / la perte	• neuron(e) / un neurone
• atrium (pl. atria) / l'atrium	• cholinesterase / la cholinestérase	• efferent / efférent	• hematoma / un hématome	• lower / inférieur (NB. "lower" est un adjectif seulement, "au dessous de" se traduit par "below")	• next / suivant
• autonomic nervous system / le système nerveux autonome	• circle / entourer, ceindre	• electrode / une électrode	• hemisphere / un hémisphère	• lumbar nerves / nerfs lombaires	• noradrenaline / la noradrénaline
• available / disponible	• clean (up) / nettoyer, purger	• electron microscope / le microscope électronique (à balayage)	• high blood pressure / l'hypertension artérielle	• lungs / les poumons	• occipital lobe / le lobe occipital
• away from / vers l'extérieur de, ailleurs	• coat / couvrir, enduire	• elsewhere / ailleurs	• hormone / une hormone	• main / principal	• opposite / oppose, inverse, en face
• axon / un axone	• coccygeal / nerfs coccygiens	• emerge from / émerger, sortir	• hydrolyze / hydrolyser	• maintain / maintenir	• outcome / le résultat final
• back / le dos	• collapse / s'effondrer	• end / extrémité, terminaison	• imbalance / un déséquilibre	• manage / gérer	• outward / extérieur, vers l'extérieur
• blindness / la cécité	• complain of / se plaindre de, consulter pour	• ending / la terminaison, l'extrémité	• impair / détériorer, affaiblir	• manquer de, ne pas avoir	• overshoot / dépasser
• blood flow / le flux sanguin	• computer simulation / une simulation informatique	• enhance / améliorer, augmenter	• impulse / une impulsion, un influx nerveux	• meal / un repas	• pain / la douleur
• blood vessel / un vaisseau sanguin	• concentration / la concentration	• enzyme / une enzyme	• increasing / en augmentation, croissant, "de plus en plus de"	• means / un moyen	• pair / une paire
• blood-brain barrier / barrière hématoencéphalique	• conductance / la conductance électrique	• era / une ère			• paralysis / la paralysie
• both / tous les deux (en même temps)		• eserine (a.k.a. physostigmine) / l'ésérine (f.) la physostigmine			• parasympathetic nervous system / le (système nerveux) parasympathique
• brain / le cerveau		• excitatory / excitant, excitateur			• parietal lobe / le lobe pariétal

## The Nervous System L3/DCEMI 2012

- *pass out (from... to) / sortir (pour aller à...)*
- *pelvic / pelvien*
- *peripheral nerves / les nerfs périphériques*
- *peristalsis / le péristaltisme*
- *permeability / la perméabilité*
- *perspiration / la transpiration*
- *pharynx / le pharynx*
- *phenomenon (pl. phenomena) / un phénomène*
- *pia mater / la pie-mère*
- *plan / planifier, faire de projets*
- *plexus / un plexus, une ramification nerveuse*
- *point to / indiquer*
- *positively / 1. positivement 2. absolument, affirmativement, avec certitude*
- *posterior / postérieur*
- *potassium / le potassium*
- *presumably / vraisemblablement, sans doute, on peut supposer*
- *previously / auparavant, précédemment*
- *prior to / précédemment, préalablement à*
- *process / traiter*
- *process / un processus, un prolongement, une ramification*
- *promote / promouvoir, favoriser*
- *pulse / le pouls*
- *ratio / une proportion, un rapport*
- *reading / la lecture*
- *realize / se rendre compte*
- *rearmost / dernier, à l'arrière*
- *receptor / un récepteur*
- *recharge / (se) recharger*
- *record / enregistrer*
- *record / enregistrer, percevoir*
- *referred to ... as / connu sous le nom de, appelé aussi, qu'on désigne sous le nom...*
- *regulate / régler, réguler*
- *release / libérer, (re)lâcher*
- *remaining / restant*
- *request / une demande*
- *reside / résider*
- *respectively / respectivement*
- *respiration rate (RR) / la fréquence respiratoire*
- *response / une réaction, une réponse*
- *resting potential / le potentiel de repos*
- *rote / appris par répétition, machinal, mécanique*
- *roughly / grossièrement, en gros*
- *run (down) / s'étendre, parcourir (de haut en bas)*
- *run... from... to / parcourir la distance entre... et, aller de... à*
- *sacral nerves / nerfs sacrés*
- *sacral plexus / le plexus sacré*
- *schedule / un planning, un programme, un emploi du temps*
- *sciatic nerve [saïatik] / le (grand) nerf sciatique*
- *scientist / un scientifique, un chercheur (NB. on utilise le nom "scientist" pour parler d'une personne, l'adjectif est toujours "scientific" p.ex. une expérience scientifique = a scientific experiment)*
- *seat / le siège de*
- *segment / un segment*
- *sense / un sens, une sensation*
- *sensory (nerve) / nerf sensoriel*
- *set / un ensemble*
- *set up / établir*
- *short / court*
- *short-term / à court terme*
- *single / unique*
- *sinoatrial node / le noeud sinusal*
- *skeletal muscle / un muscle squelettique*
- *skin / la peau*
- *skin / la peau*
- *skull / le crâne*
- *slight / léger, à peine perceptible*
- *smell / une odeur*
- *smooth muscle / un muscle lisse*
- *sodium / le sodium*
- *somehow / d'une façon ou d'une autre*
- *space / un espace*
- *spatial relationship / une relation dans l'espace, une relation spatiale*
- *speech / la parole, le langage*
- *spinal cord (spine) / la moelle épinière, la corde dorsale, le cordon médullaire*
- *spinal cord / le cordon médullaire, la corde dorsale, la moelle épinière*
- *spinal nerves / les nerfs rachidiens, racine nerveuse (NB. ≠ nerf spinal, la 11e paire crânienne permettant la contraction des muscles trapèze et sterno-cléido-mastoïdien = accessory nerve)*
- *squid / un calamar*
- *state / un état*
- *stimulate / stimuler*
- *storage / le stockage, la mise en mémoire*
- *stroke / un accident vasculaire cérébral*
- *subarachnoid space / l'espace subarachnoïdien*
- *supply / alimenter, innervé, desservir*
- *surface area / la superficie, la surface*
- *surround / entourer*
- *sympathetic (nervous system) / le (système nerveux) sympathique*
- *synapse / une synapse*
- *temporal lobe / le lobe temporal*
- *thick / épais*
- *thigh / la cuisse*
- *thoracic nerves / nerfs dorsaux, nerfs thoraciques*
- *thorax / le thorax*
- *thought / la pensée*
- *thus / ainsi*
- *tissue / le tissu*
- *together / ensemble*
- *toxin / une toxine*
- *upper / supérieur (NB. "upper" est un adjectif seulement, "au dessus de" se traduit par "above")*
- *vagus nerve / le nerf vague, le nerf pneumogastrique*
- *vary / varier*
- *vasoconstriction / la vasoconstriction*
- *vesicle / une vésicule*
- *voluntary / volontaire*
- *waste / un déchet*
- *wave / une onde*
- *within / à l'intérieur de*
- *within / en moins de, en l'espace de, en quelques seulement*