BIOLOGY HIGHLIGHTS – *KEYS*

Watch the videos and download the transcripts of this section at:
online.scuola.zanichelli.it/curtisnuovoinvitoblu/clil

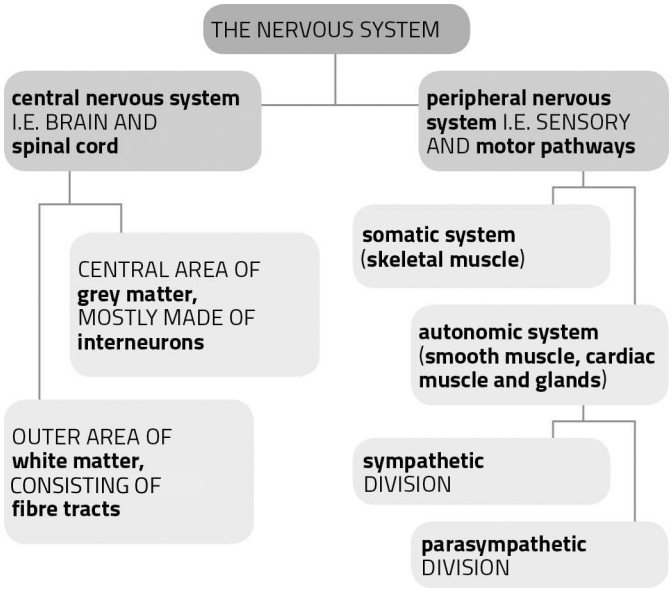
> THE HUMAN NERVOUS SYSTEM

2. WARM UP
a) The structures that form the nervous system are the central nervous system (brain and spinal cord) and the peripheral nervous system.
b) We couldn't walk, think, or even breathe!
c) The brain.
d) It uses electrochemical impulses.

3. VISUAL LEARNING
A. Cell body; B. Dendrites; C. Axon; D. Schwann cell; E. Node of Ranvier; F. Nucleus

4. VOCABULARY
a) central; spinal cord b) signals; c) voluntary; d) events; stimuli e) synapses; effector cells

5. READING
Track C1



6. VIDEO

Video C1
Transcript
The basic functional unit of the nervous system is the neuron.
It is a specialized cell formed by a cell body, which contains the nucleus and most of the organelles, and two types of projections. The most numerous projections are the dendrites, which may be branched, and receive information from other neurons and convey it to the cell

body. The other type of projection is an axon, which is longer than dendrites and transmits information to other cells, even over great distances.
The ability to convey information depends on neuron excitability, i.e. the ability to generate and transmit an electrical signal. The nerve impulse is in fact nothing more than a temporary reversal of electric potential: the negative interior of the membrane becomes positive and this reversal is propagated in one direction only.
The mechanism is explained at a molecular level by the movement of ions through channels and ion pumps in the membrane.
Sodium channels, potassium channels and sodium-potassium pumps generate the resting potential, which is negative on the inside. Channels allow ions to pass through to an area of lower concentration: sodium enters the axon and potassium leaves.
The sodium-potassium pump counteracts the effect of these movements by moving sodium outside and potassium inside. The pump maintains the concentration gradient of the two ions, by consuming energy.
During each transport cycle the pump binds three sodium ions inside and moves them outside thanks to the energy of one ATP molecule. As soon as it releases the sodium, it binds two potassium ions and moves them inside.
Resting conditions change following stimuli: specific voltage-gated sodium channels open and sodium ions enter, making the potential more positive.
If the stimuli are sufficient to exceed the threshold value other sodium channels are activated and the nerve impulse, called the action potential, is generated.
The positive potential inactivates the sodium channels, and opens potassium channels. Potassium leaving the axon makes the potential more negative than the resting potential for a short period, called the refractory period, and then the resting potential is restored.
The entire sequence of events lasts a few milliseconds.
The electrical activity associated with the nerve impulse can be measured. In the graph the potential in millivolts (ordinate, or y axis) has been plotted against time in milliseconds (abscissa, or x axis). From the resting potential of about -70 mV, the potential becomes more positive with the entry of sodium ions. Once the threshold value has been exceeded, more sodium channels open: the massive flow of sodium ions inside produces the positive peak that corresponds to the action potential. This positive value inactivates the sodium channels and opens voltage-gated potassium channels: positive charges moving out of the axon make the potential more negative than the resting potential, but after this refractory period the resting potential is restored.
During the refractory period the membrane does not respond to stimuli, which prevents the action potential from travelling backwards.
In this way the nervous impulse generated in the cell body reaches the axon terminal, the swelling at the end of the axon.

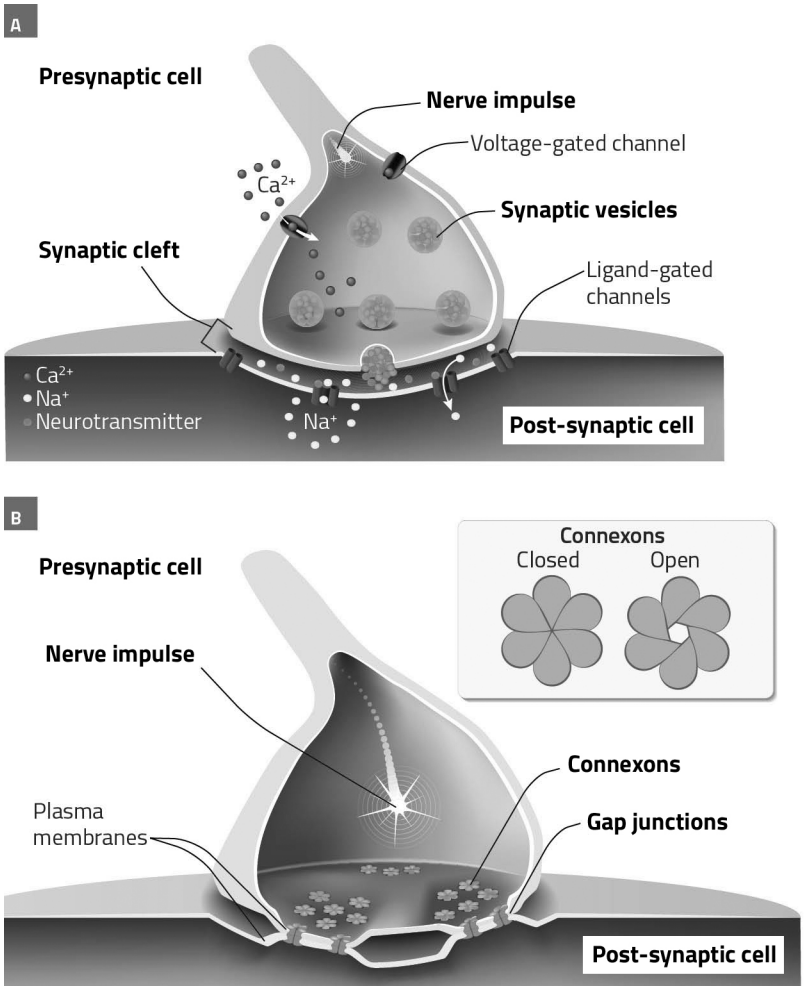
Keys
a) F (*It is the neuron*); b) F (*Dendrites are projections coming out of the neuron's cell body*); c) F (*Axons are longer than dendrites, and transmit information to other cells*); d) T; e) T; f) F (*The negative interior of the membrane becomes positive*); g) T; h) T; i) T; j) F (*Action potential is the short-lasting event of the nerve impulse*). k) T; l) F (*The entire sequence of events lasts a few milliseconds*); m) T; n) F (*In the graph, the action potential takes place at its peak*). o) F (*After the refractory potential, the resting potential is restored*); p) F (*The membrane does not respond to stimuli so as to avoid the action potential to travel back*).

7. PAIR WORK
a) A nerve impulse is an electrical current that travels along dendrites or axons due to ions moving through voltage gated channels.
b) It is a gated channel, i.e. a pomp that sends sodium ions out of the cell and brings potassium ions in.
c) The resting membrane potential is the difference in charge between the interior and the exterior of the nervous cell.
d) Nerve impulses are transmitted by the movement of two ions: sodium (Na^+) and potassium (K^+). Sodium rushes into a neuron as a nerve impulse travels, and is actively pumped out

again in preparation for conducing another nerve impulse. Potassium ions then return the electrochemical gradient to the resting state.

8. APPLY YOUR NEW KNOWLEDGE

Track C2



9. VOCABULARY

A-1; B-5; C-4; D-4; E-3

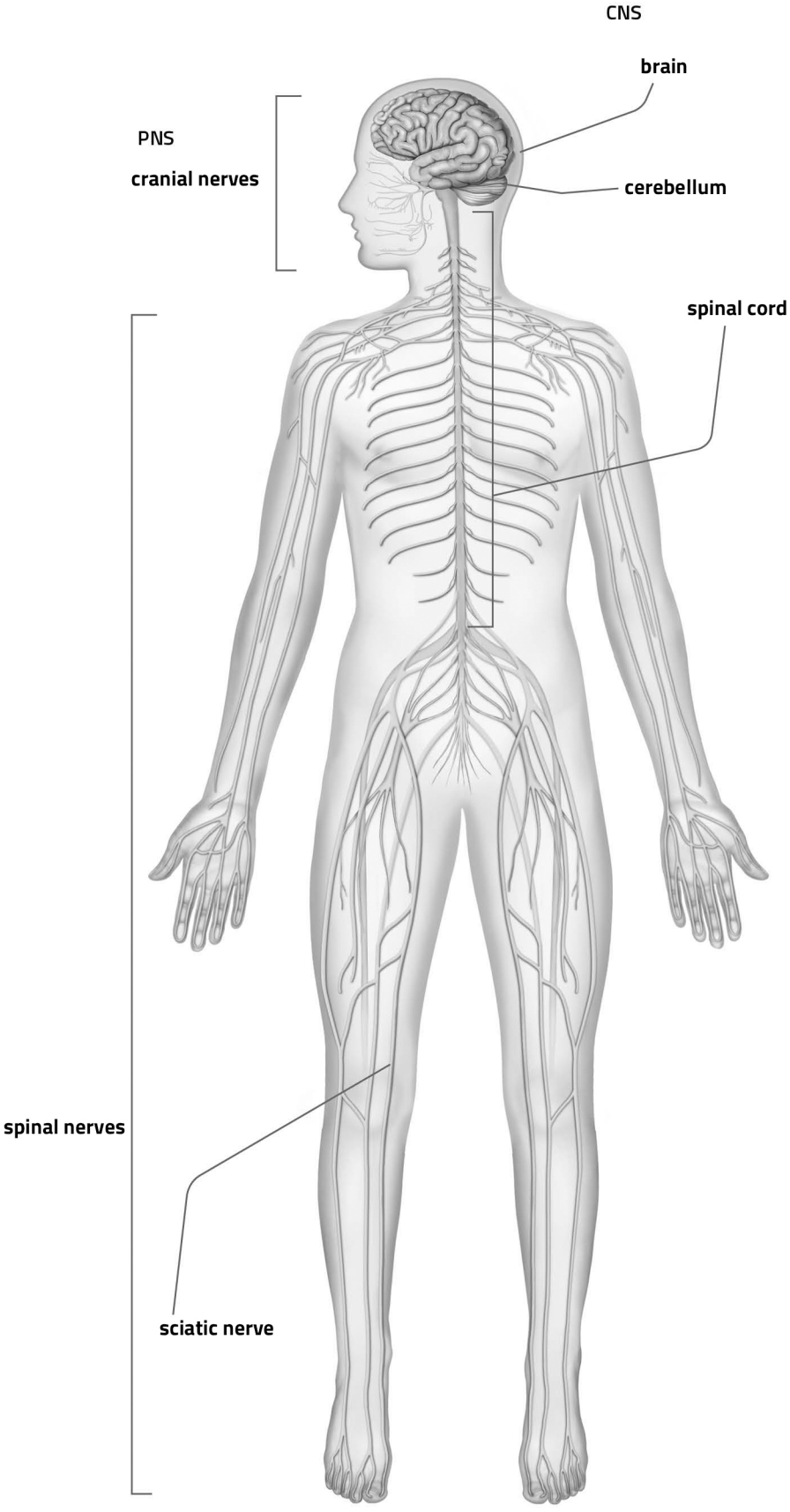
10. DISCUSSION

Free answer

11. REVISION

Free answer

12. EXPLORE FURTHER



FINAL TEST

1. C; 2. D; 3. D; 4. C; 5. B; 6. B; 7. D; 8. C;
9. A nerve impulse is an *electrical* current that travels along *dendrites* or *axons* due to ions moving through voltage gated channels.
10. It is a gated channel, i.e. a pump that sends *sodium* ions out of the cell and brings *potassium* ions in.
11. The resting membrane potential is the difference in charge between the *interior* and the *exterior* of the nervous cell.
12. Nerve impulses are transmitted by the movement of two *ions*: sodium (Na^+) and potassium (K^+).
Sodium rushes into a neuron as a nerve impulse travels, and is actively pumped out again in preparation for conducing another nerve impulse. *Potassium* ions then return the electrochemical gradient to the resting state.
13. Nerves are the cordlike bundles of *fibres* that conduct *nerve* impulses.
14. Meninges (singular, meninx) are the three *membranes* that envelop and protect the brain and the spinal cord.
15. Myelin is a fatty substance that surrounds the *axon*. Of some neurons, forming an electrically insulating layer.