



لجان الدفوعات

PHYSIOLOGY

MORPHINE ACADEMY

MORPHINE
ACADEMY



PHYSIOLOGY

FACULTY OF PHARMACEUTICAL SCIENCES

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LECTURE 3, PART (2): INTRODUCTION OF THE NERVOUS SYSTEM

Objectives

← جهاز عصبي مركزي : Brain + spinal cord

1. Discuss **central nervous system (CNS)** as well as **peripheral nervous system (PNS)**.

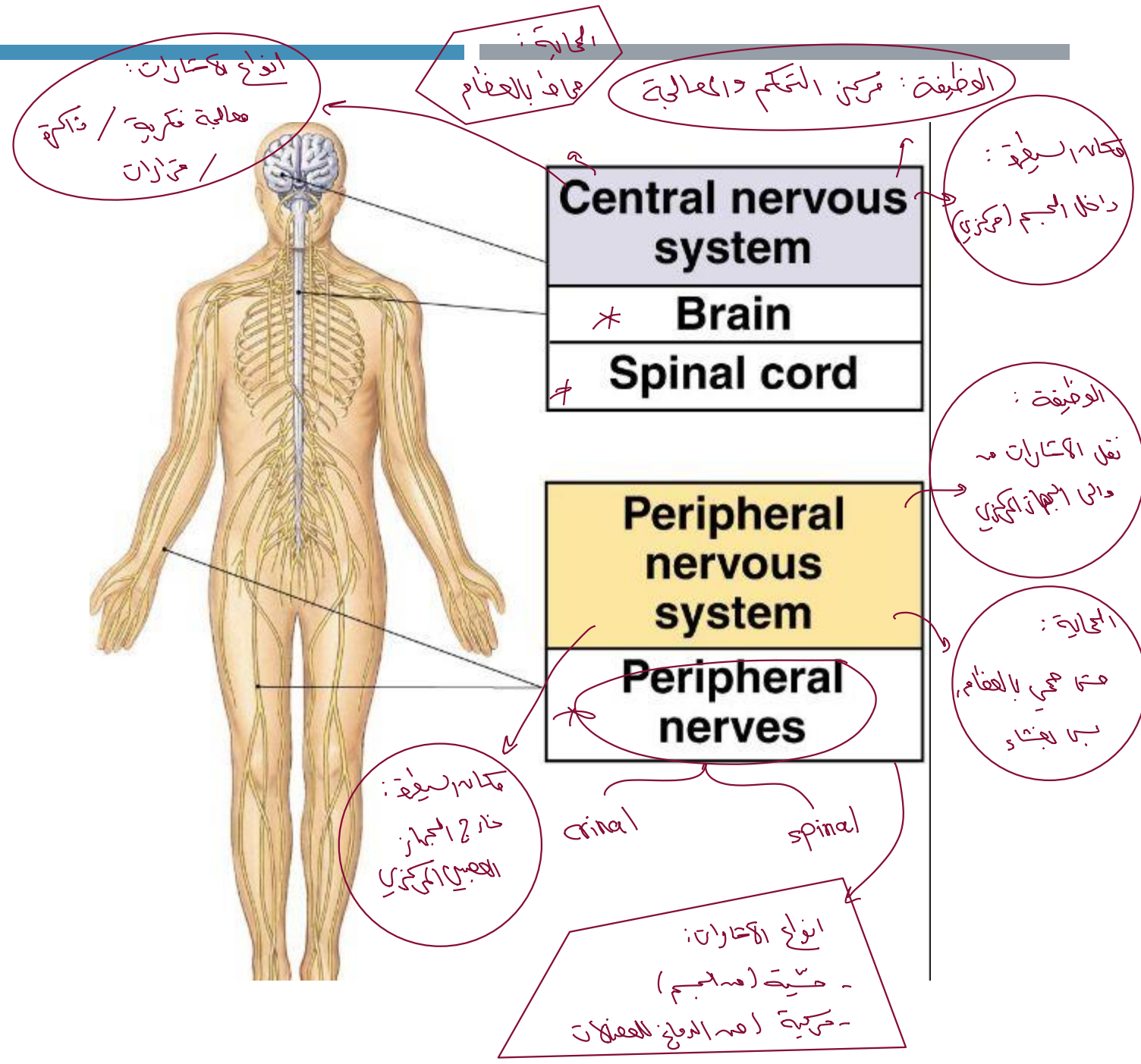
← جهاز عصبي مركزي : الجهاز العصبي المركزي ، الجهاز العصبي المحيطي : PNS

2. Describe **functions of the nervous system**.

3. Explore **classification of neurons**.

(Pages 400- 408 of the reference)

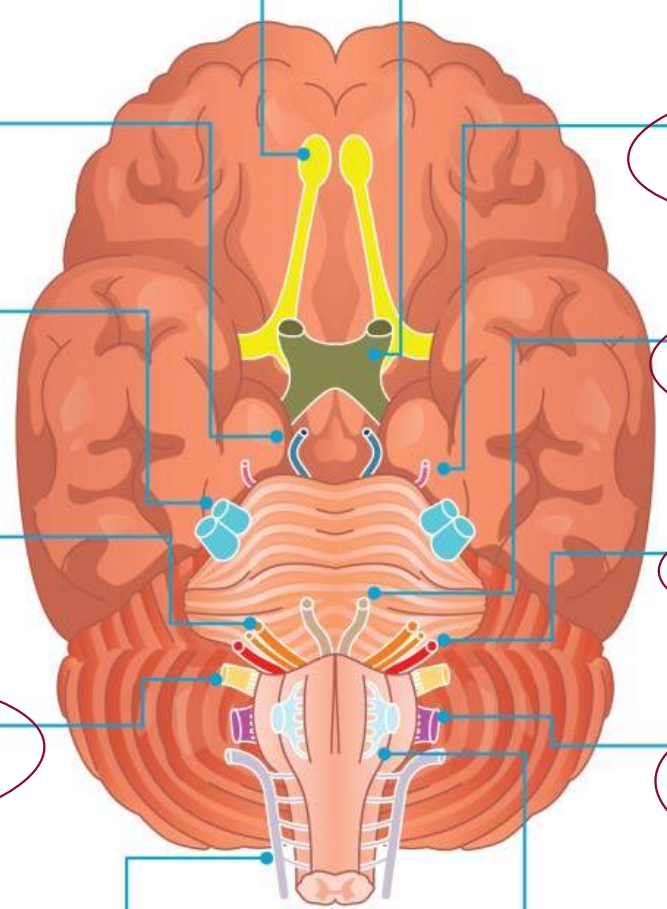
The nervous system is one of the smallest (3% of the total body weight) but the most complex of the 11 body systems.



12 Cranial Nerves

تتبع الجهاز PNS لأنها تخرج من الدماغ لتصل بالـ peripheral nerves.

12/9/2012 من الأعصاب تخرج من الدماغ مباشرة (من قبل الحوكم) ، وكل عصب له وظيفة محددة



olfactory
smell

للحجم

optic
vision

العين

oculomotor
eye movement and pupil reflex

حركة العين - تضيق البؤبؤ

trochlear
eye movement

حركة العين
(العصلة العلوية)

trigeminal
face sensation and chewing

الاحساس بالوجه والعض.

abducens
eye movement

حركة العين
الجانبية.

facial
face movement and taste

تحريك الوجه والتذوق.

vestibulocochlear
hearing and balance

السمع والتوازن

glossopharyngeal
throat sensation, taste, and swallowing

التذوق - البلع - تضييق البلعوم.

vagus
movement, sensation, and abdominal organs

التحكم بالأعضاء الداخلية
(القلب / المعدة ...)

accessory
neck movement

حركة الرقبة والكتف.

hypoglossal
movement, sensation, and abdominal organs

حركة اللسان.

Spinal Nerve Function

Every Cell of Your Body Has a Nerve Component

طاي الاعصاب الخارجة
من الجبل الحوكي - مدنها
الوزن وبتنقسم حسب المنطقة

VERTEBRAL LEVEL	NERVE ROOT*	INNERVATION	POSSIBLE SYMPTOMS
C1	C1	Intracranial Blood Vessels	Headaches • Migraine Headaches
C2	C2	• Eyes • Lacrimal Gland	• Dizziness • Sinus Problems
C3	C3	• Parotid Gland • Scalp	• Allergies • Head Colds • Fatigue
C4	C4	• Base of Skull • Neck Muscles • Diaphragm	• Vision Problems • Runny Nose • Sore Throat • Stiff Neck
C5	C5	• Neck Muscles • Shoulders	• Cough • Croup • Arm Pain
C6	C6	• Elbows • Arms • Wrists	• Hand and Finger Numbness or Tingling • Asthma • Heart Conditions • High Blood Pressure
C7	C7	• Hands • Fingers • Esophagus • Heart • Lungs • Chest	
C8	C8		
T1	T1	Arms • Esophagus	Wrist, Hand and Finger Numbness or Pain • Middle Back Pain • Congestion • Difficulty Breathing • Asthma • High Blood Pressure • Heart Conditions
T2	T2	• Heart • Lungs • Chest	
T3	T3	• Larynx • Trachea	
T4	T4		
T5	T5	Gallbladder • Liver	
T6	T6	• Diaphragm • Stomach	• Bronchitis • Pneumonia
T7	T7	• Pancreas • Spleen	• Gallbladder Conditions
T8	T8	• Kidneys • Small Intestine	• Jaundice • Liver Conditions
T9	T9	• Appendix • Adrenals	• Stomach Problems • Ulcers
T10	T10	Small Intestines • Colon	• Gastritis • Kidney Problems
T11	T11	• Uterus	
T12	T12	Uterus • Colon • Buttocks	
L1	L1	Large Intestines	Constipation • Colitis • Diarrhea
L2	L2	• Buttocks • Groin	• Gas Pain • Irritable Bowel
L3	L3	• Reproductive Organs	• Bladder Problems • Menstrual Problems • Low Back Pain
L4	L4	• Colon • Thighs • Knees	• Pain or Numbness in Legs
L5	L5	• Legs • Feet	
S1	S1	Buttocks • Reproductive Organs • Bladder	Constipation • Diarrhea • Bladder Problems • Menstrual Problems
S2	S2	• Prostate Gland • Legs	• Lower Back Pain • Pain or Numbness in Legs
S3	S3	• Ankle • Foot • Toe	
S4	S4		
S5	S5		
S6	S6		
S7	S7		
S8	S8		
S9	S9		
S10	S10		
S11	S11		
S12	S12		

REFERENCES:
* J. D. Ph.D. Neuroanatomy,
4th Edition, Lippincott Williams &
Wilkins, 2002.

Undel, E. R., Schwartz, J. H.
Russell, T. M., Principles of
Neural Science, Appleton &
Lange, 1999.

Oppenfeld, S. M.D.
Physical Examination
of the Spine and
Extremities,
Appleton-Century-
Coff, 1976.

Netter, K. H.
D. The Ciba
Collection
of Medical
Illustrations, Vol.
Nervous System,
Part 1, Anatomy
and Physiology, Ciba
Pharmaceuticals Division,
Basel, 1991.

C₁-C₈: Cervical (عنق)

8 pairs

اليد والذراع والرقبة +
الذراعين.

T₁-T₁₂: Thoracic (صدر)

12 pairs

الصدر + البطن +
الداخلية.

L₁-L₅: Lumbar (قطن)

5 pairs

فعل البطن +
الذراعين.

Spinal Nerves

- 31 Pairs of spinal nerves
- Named & numbered by the cord level of their origin

عنقي ← 8 pairs of cervical nerves (C1 to C8)

صدري ← 12 pairs of thoracic nerves (T1 to T12)

قطني ← 5 pairs of lumbar nerves (L1 to L5)

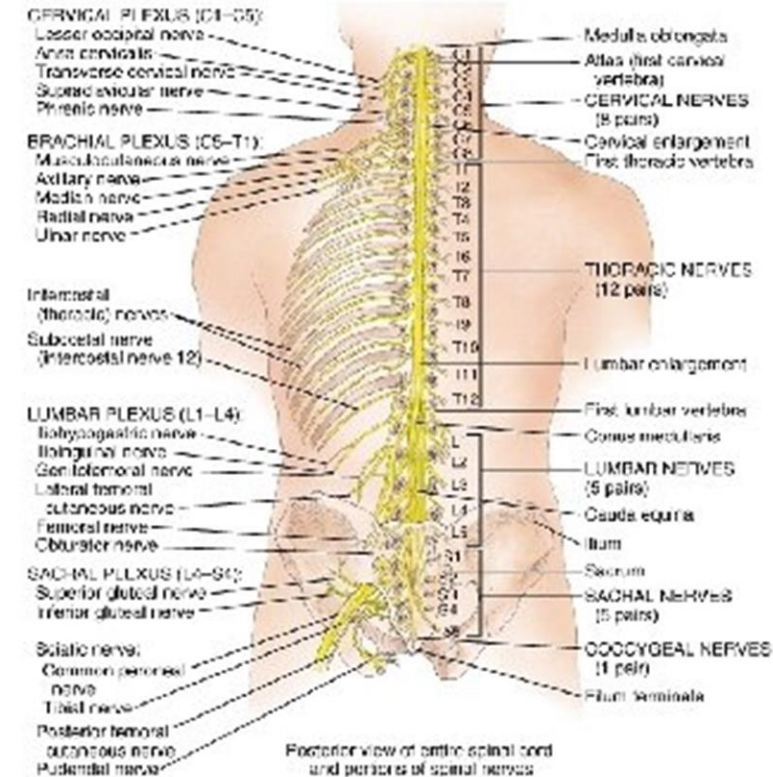
كعبي ← 5 pairs of sacral nerves (S1 to S5)

عصبي ← 1 pair of coccygeal nerves

- Mixed sensory & motor nerves

تنقل الاحساس للدماغ

تنقل الاوامر من الدماغ للعصبونات



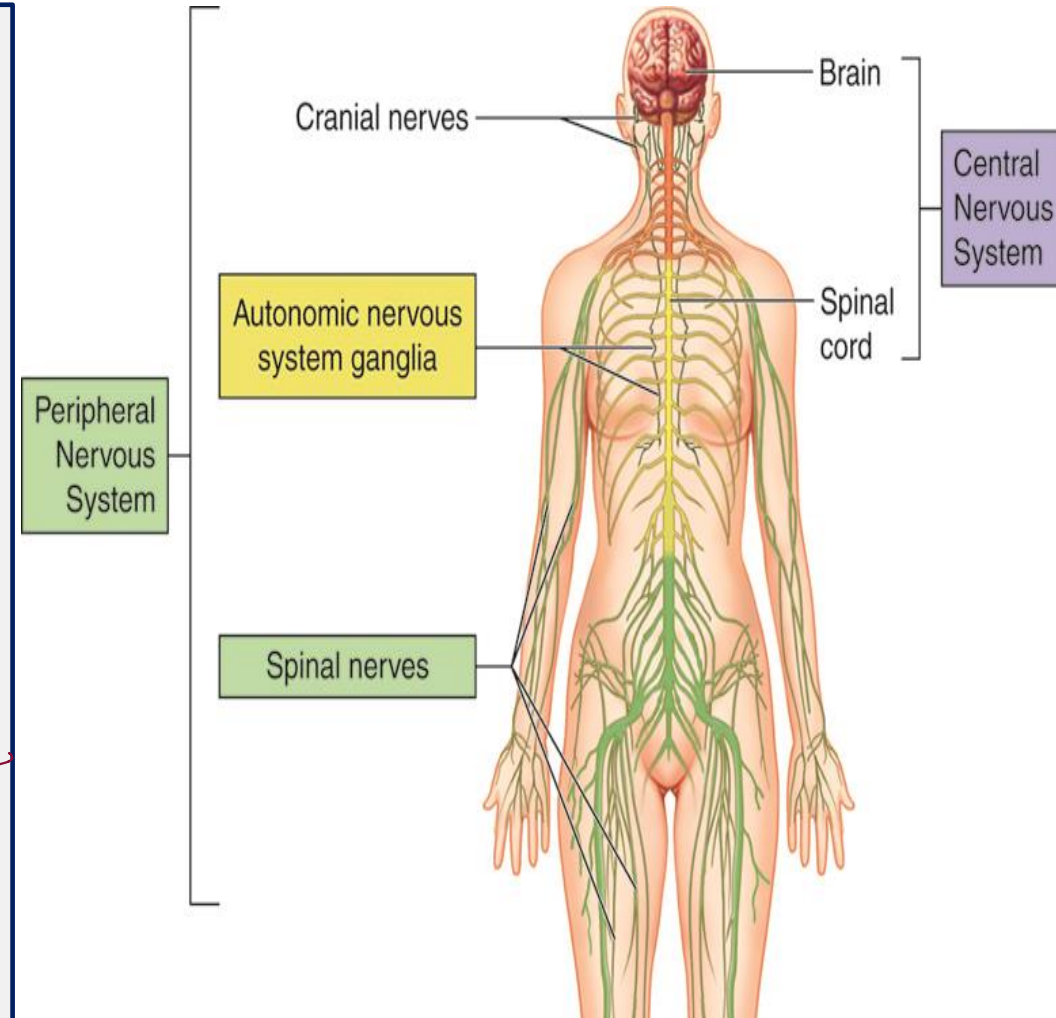
مختلطة حسية وحركية mixed nerves

NERVOUS SYSTEM

CNS

PNS

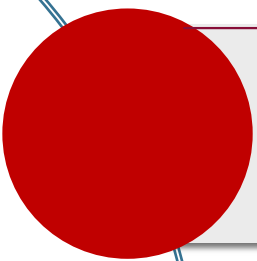
- It consists of **central nervous system (CNS)** and **peripheral nervous system (PNS)**.
- The **CNS** consists of **brain (85 billion neurons)** and **spinal cord (100 million neurons)**.
- The **PNS** consists of all nervous tissue outside the CNS, which include **nerves**, **ganglia**, **enteric plexuses**, and **sensory receptors**.



PERIPHERAL NERVOUS SYSTEM

1. **Nerve** is a ^{حزمة} bundle of hundreds to thousands of ^{مادور حصبية} axons plus associated connective tissue and blood vessels that ^{موجود خارج} lies outside the brain and spinal cord (i.e., **cranial nerves** ^{تخرج} emerge from the brain and **spinal nerves** emerge from the spinal cord).
2. **Ganglia** are small masses of nervous tissue, that are located outside of the brain and spinal cord.
3. **Enteric plexuses** are extensive networks of neurons located in the walls of organs of the gastrointestinal tract (regulating the digestive system).
^{مدار القناة الهضمية}
^{# وظيفتها تنظيم الجهاز الهضمي وأجزاءه.}
4. **Sensory receptor** refers to a structure of the nervous system that monitors changes in the external or internal environment.

PERIPHERAL NERVOUS SYSTEM

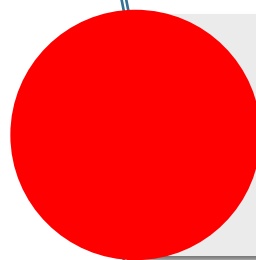


Somatic nervous system (SNS)

المتحكم

إرادي -

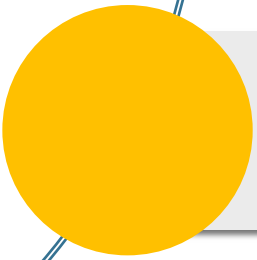
conscious



Autonomic nervous system (ANS)

إلزامي -

Involuntary



Enteric nervous system (ENS)

جهاز
هضمي

SOMATIC NERVOUS SYSTEM (SNS) (CONSCIOUSLY CONTROLLED)

تنقل المعلومات من المستقبلات الحسية (بالرأس + جدار الجسم + الأطراف) إلى CNS

1. Sensory neurons that convey information to CNS from somatic receptors in the head, body wall, and limbs and from receptors for the special senses of vision, hearing, taste, and smell.

تنقل الأوامر

2. Motor neurons that conduct impulses from the CNS to skeletal muscles only.

يعني إذا SNS هو المسؤول عن الحركة



الذاتي - لا إرادي.

هو القسم من الجهاز العصبي الذي لا يتحكم به الإنسان بوعي أو إرادة فكل.

AUTONOMIC NERVOUS SYSTEM (ANS) (INVOLUNTARY)

يعني الجهاز العصبي فيه تتنقل به عي أو إرادة فكل.

1. **Sensory neurons** that convey information to CNS from autonomic sensory receptors, located primarily in visceral organs such as the stomach and lungs.

تقل الإشارات العصبية من ANS إلى:

زيتي صابون بقدر الحاجة
يعود لكل

2. **Motor neurons** that conduct nerve impulses from the CNS to smooth muscle, cardiac muscle, and glands.

زيتي لأوعية الدموية والغدة

عضلة القلب

غدد

الجهاز الحركي من ANS ينقسم إلى قسمين متعاكسين بالوظيفة:

Note: The motor part of the ANS consists of two branches, the sympathetic division and the parasympathetic division.

Division	Function
sympathetic Division.	* تنشيط الجسم بحالات الطوارئ أو الهرب (Fight or Flight) * يزيد معدل ضربات القلب والتنفس ويزيد ضغط الدم.
Parasympathetic Division	* يثبط الجسم لحالة الراحة (Rest and Digest) * يبطئ القلب. * يحفز الجهاز الهضمي والبولي.

التوازن بين الفئتين يحافظ على استقرار الجسم (Homeostasis)

ENTERIC NERVOUS SYSTEM (ENS) (THE BRAIN OF THE GUT) (INVOLUNTARY)

هذه كلها بشكل مستقل نسبيًا عن الدماغ + هو جزء لا إرادي من الجهاز العصبي المركزي. - الجهاز العصبي المعوي.

1. **Sensory neurons** of the ENS monitor chemical changes within the GI tract as well as the stretching of its walls.

تتمدد جدار الأمعاء.

جهاز عصبي

2. **Motor neurons** govern contractions of GI tract smooth muscle to propel food through the GI tract, secretions of GI tract organs (such as acid from the stomach and hormones from GI tract endocrine cells).

ENS تتحكم فيها:

بالتالي، الـ ENS مسؤول عن تنسيق الحركة

والافرازات داخل الجهاز الهضمي من أجل
لاشارات من الدماغ.

① انقباض العضلات الملساء بالجهاز الهضمي لتسهيل الطعام

عبر القناة الهضمية.

② إفرازات الجهاز الهضمي

FUNCTIONS OF THE NERVOUS

* مثال قلبي:
انت لمسة على جرحه - المستقبلات الحسية أرسلت
إشارة للدماغ Sensory ،
الدماغ يقرر يجب ان يكون Integrative ،
الأوامر تنروح للعفلة motor .

وظيفة حسية

Sensory function (detecting internal stimuli or external stimuli through cranial and spinal nerves).

وظيفة تكاملية

Integrative function (analyzing) sensory information and making decisions for appropriate responses).

وظيفة حركية

Motor function (eliciting an appropriate motor response by activating effectors (muscles and glands) through cranial and spinal nerves).

يسر الجهاز العصبي أوامر للعفلة والعضلات لتنفيذ الاستجابة المطلوبة (مثل انكبة أو الاغتراب)

وظائف الجهاز العصبي (بشكل عام)			
ANS	ENS	وجه المقارنة	
التحكم	لا إرادي (Involuntary)	لا إرادي (Involuntary)	مزيج من الإرادي واللا إرادي
الموقع	في الأعضاء الداخلية (القلب، الرئتين، الأوعية...)	في جدران الجهاز الهضمي	يشمل الجسم كله
الأجزاء	Sympathetic + Parasympathetic	شبكات عصبية داخل القناة الهضمية	Sensory + Integrative + Motor
الخلايا الحسية	من الأعضاء الحشوية إلى CNS	من جدار الأمعاء	من المستقبلات إلى CNS
الخلايا الحركية	إلى العضلات الملساء والقلب والغدد	إلى عضلات الجهاز الهضمي والغدد	إلى العضلات أو الغدد
الوظيفة الأساسية	تنظيم وظائف الجسم التلقائية	التحكم بحركة وإفرازات الهضم	استقبال، تحليل، واستجابة للمؤثرات

1. Why does the ANS operate involuntarily?

→ Because it controls internal organs that must function automatically for survival (like the heart and digestion).

2. What is the main difference between the ANS and ENS?

→ The ENS is limited to the digestive system, while the ANS regulates all internal organs.

3. Why is the ENS called the "Brain of the Gut"?

→ Because it can control digestion independently of the brain.

① Which of the following is not controlled by the autonomic nervous system?

- A- Cardiac muscle B- Smooth muscle C- Skeletal muscle D- Glands

② The "fight or flight" response is governed by the:

- A- Parasympathetic division B- Sympathetic C- Enteric division D- Somatic Division

③ The enteric nervous system mainly regulates:

- A- Blood pressure B- Digestive activities C- Muscle contraction of limbs D- Heartbeat.

④ Which function of the nervous system involves analyzing sensory input and making decisions?

- A- Sensory function. B- Integrative C- Motor function D- Reflex function.

Answers: 1 C 2 B 3 B 4 B

من أنسجة الجسم التي يكون لها الدماغ والجهاز العصبي وظائف.

NERVOUS TISSUE

Neurons

Synapse

من الخلايا التي تتصل بالوظائف بالجهاز العصبي

خلايا عصبية

موجودة
بالدماغ والجهاز العصبي
والأعضاء.

Neurons (provide most of the unique functions of the nervous system, such as sensing as they connect all regions of the body to the brain and spinal cord). (No ability to undergo dividing throughout an individual's lifetime.) لا تنقسم أو تتجدد بعد النضج (يعني ما يتكاثر)

موجودة
بالجهاز العصبي
كله.

Neuroglia (support and protect neurons, and maintain the interstitial fluid that bathes them) (they outnumber neurons). It has a continuous ability to divide throughout an individual's lifetime.) لا تنقسم أو تتجدد بعد النضج (يعني ما يتكاثر)

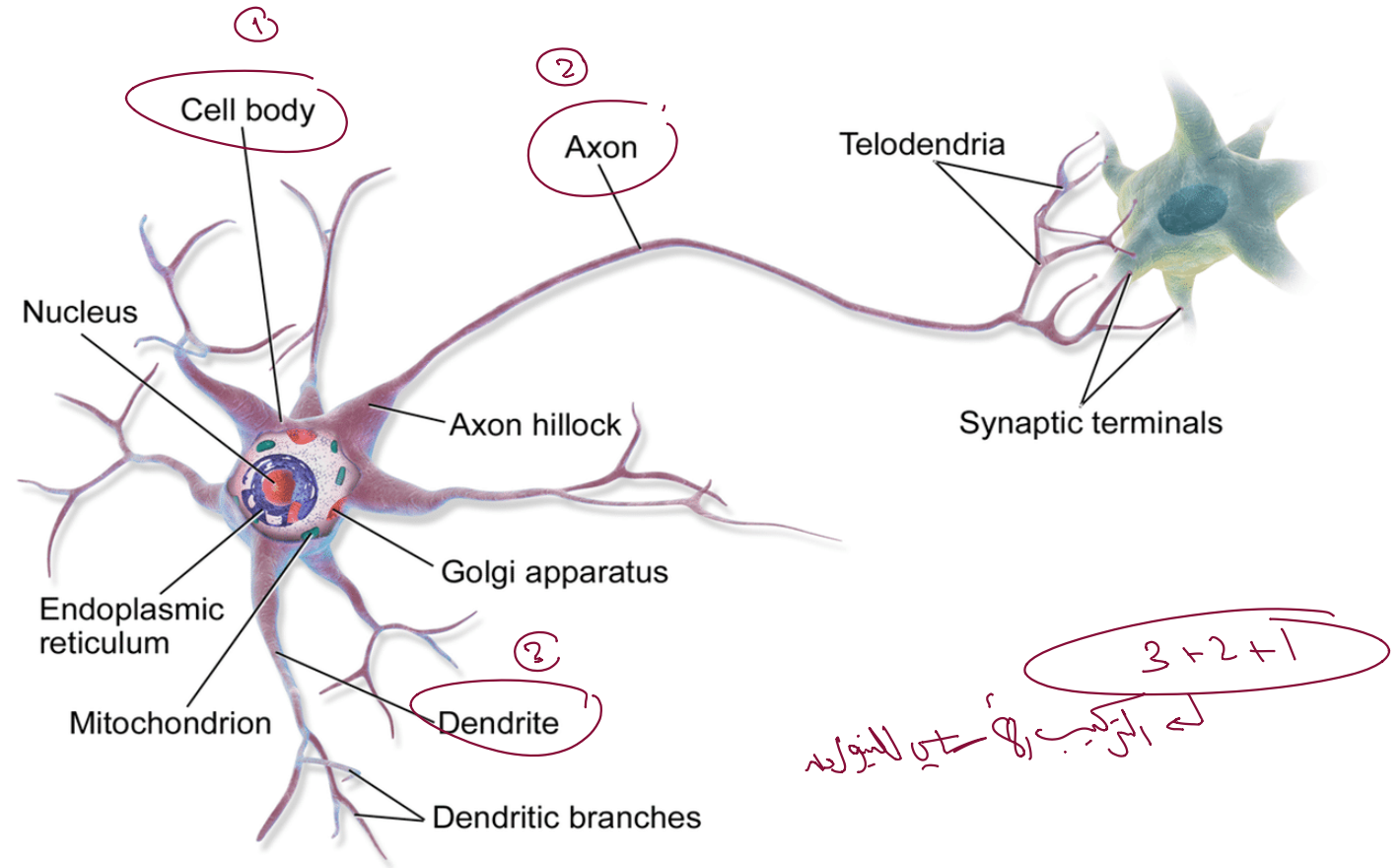
أعدادها كثر كثير.

تتمثل بقدرتها على الاستجابة للمثيرات stimuli وتحويلها إلى إشارات كهربائية (Action potentials)

The neuron has the ability to respond to a stimulus and convert it into an action potential (nerve impulses).

The cell body contains free ribosomes and rough endoplasmic reticulum for synthesizing new proteins. .

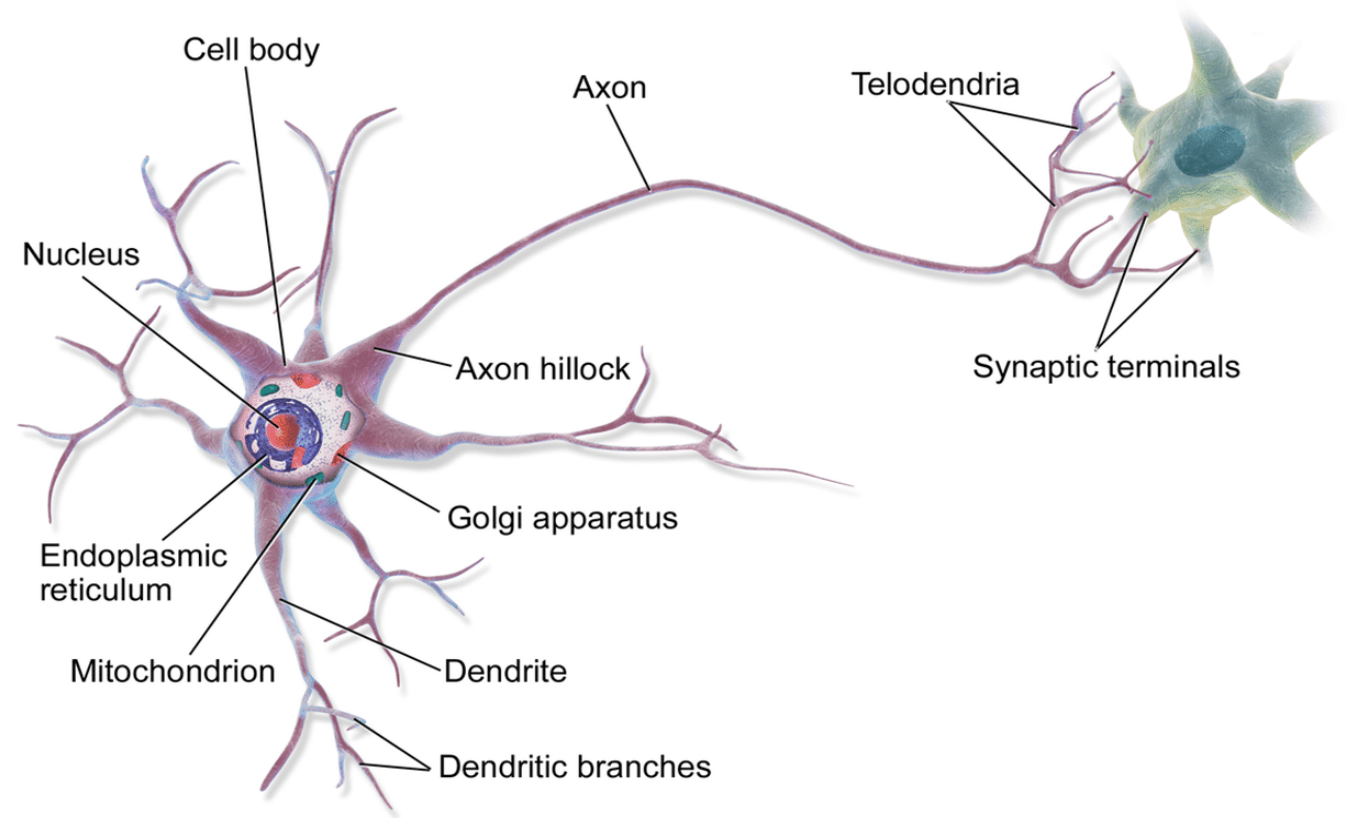
Neuron



تقریبات سجرہ

The dendrites (like little trees) are the receiving or input portions of a neuron because they contain numerous receptor sites for binding chemical messengers from other cells.

Neuron

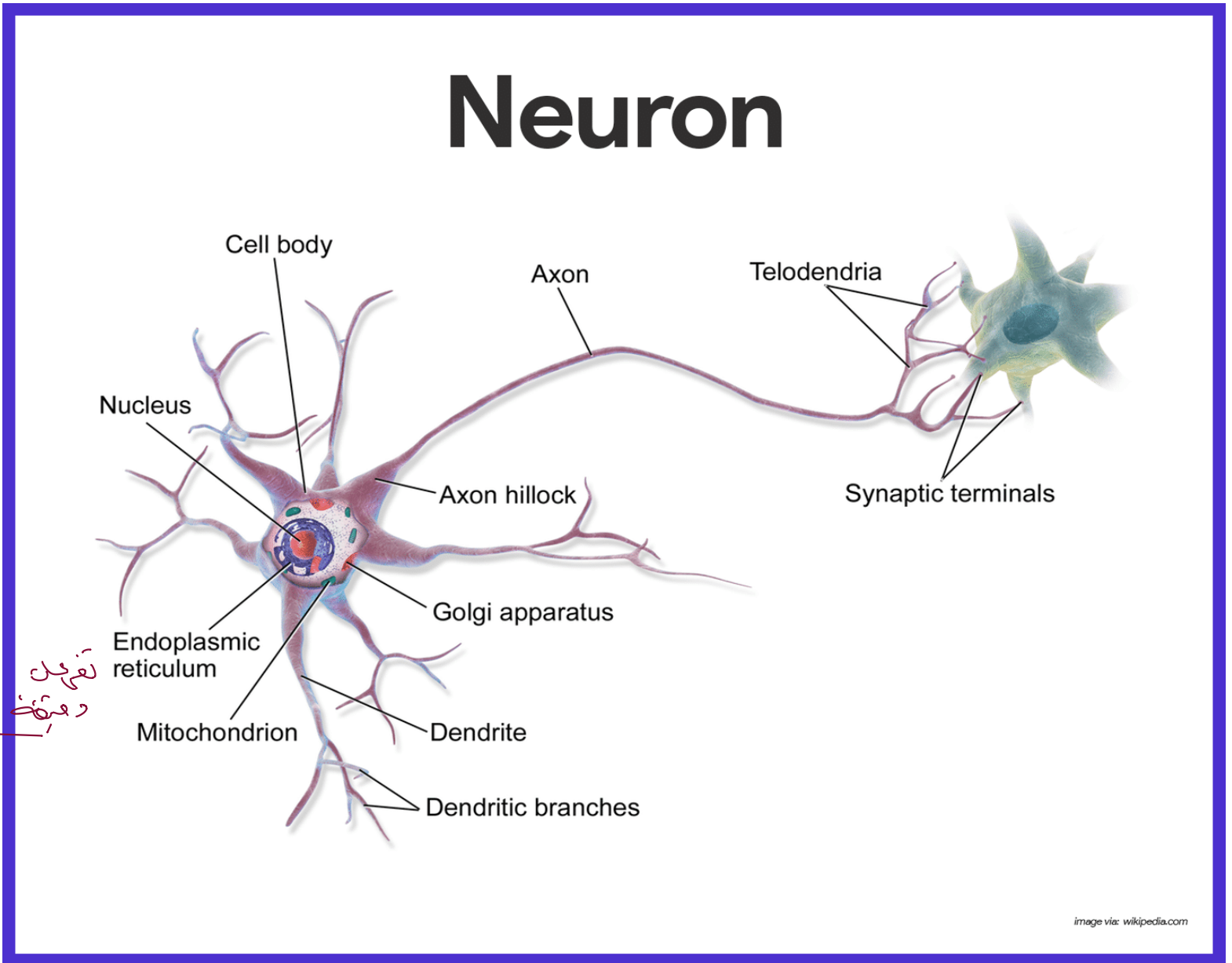


امتداد طويل ورفيع ينقل النبضات العصبية بعيداً عن جسم الخلية ثابتة أو متحركة.

المحور العصبي

The single axon (long and thin projection) of a neuron propagates nerve impulses toward another neuron, a muscle fiber, or a gland cell.

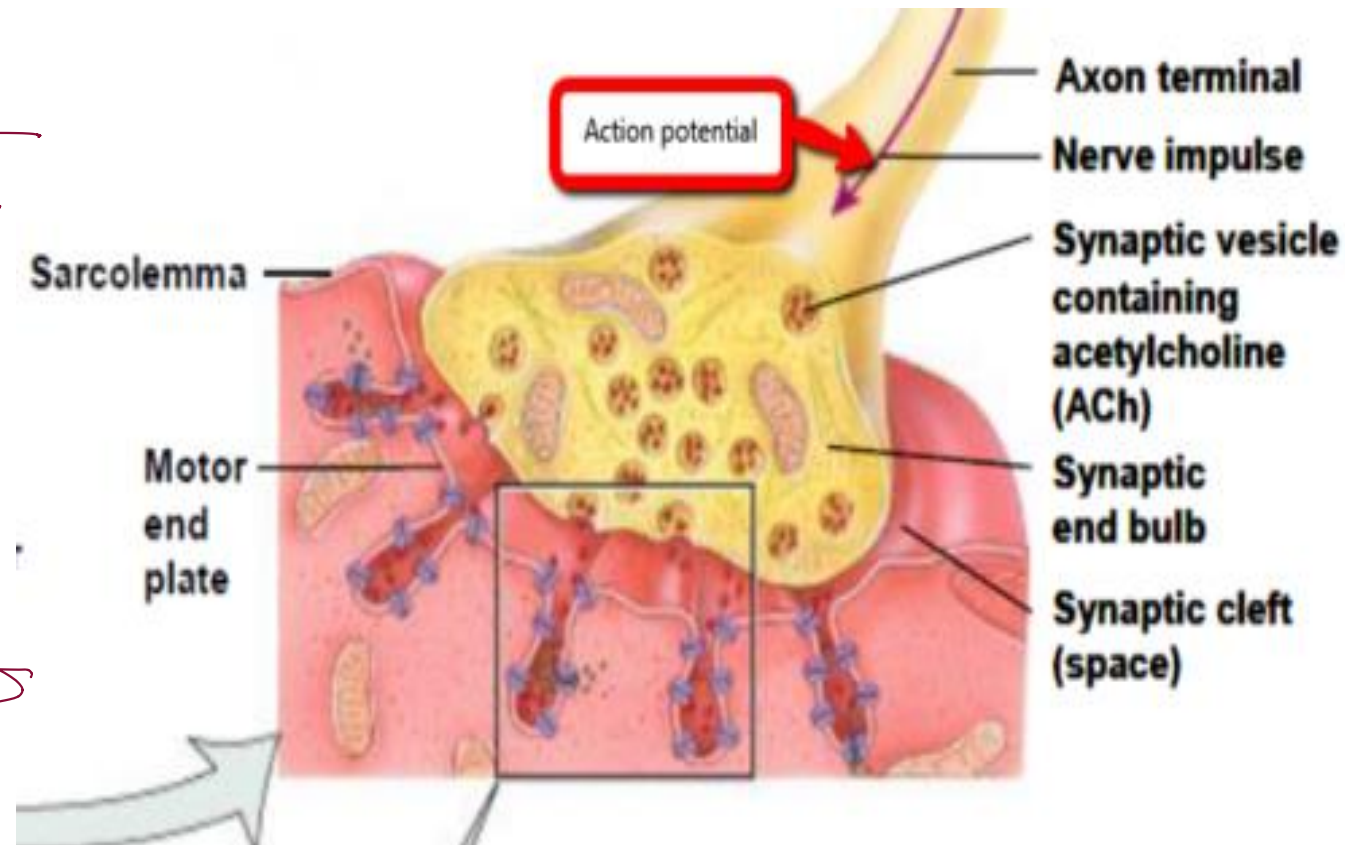
The axon ends by dividing into many fine processes called axon terminals.



SYNAPSE

مُتَابِلُ الْعَصَبِي

- Synapse is the site of communication between two neurons or between a neuron and an effector cell. (خَلِيَّة عَصَبِيَّة / خَلِيَّة / خَلِيَّة عَصَبِيَّة)
- Some axon terminals swell into bulb-shaped structures called **synaptic end bulbs**. (مُتَابِلَات خَتَامِ الْعَصَبِيَّةِ)
- **Synaptic end bulbs** contain many tiny membrane-enclosed sacs called synaptic vesicles that store a chemical called a neurotransmitter. (الْمَادَّةُ الْعَصَبِيَّةُ)



SYNAPSE

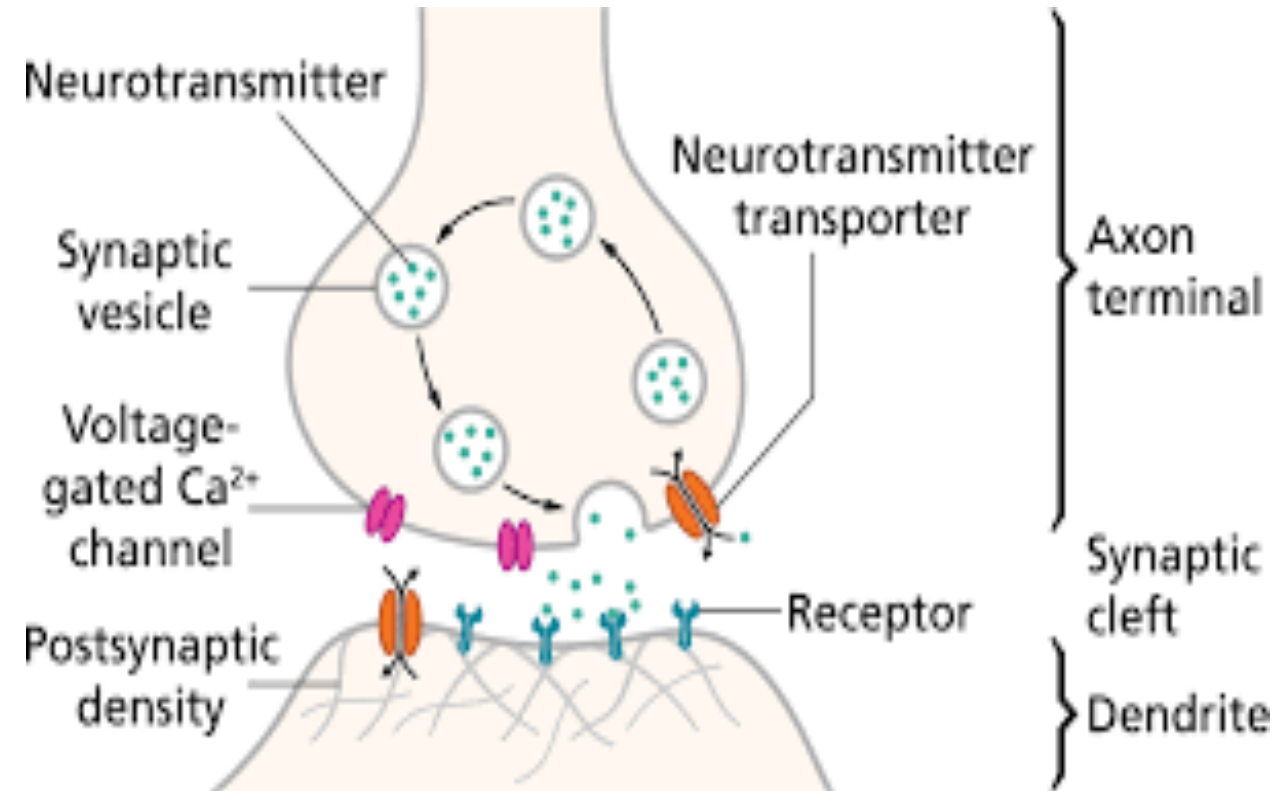
الخلاصة:

لا تعمل الخلايا العصبية لنقل الإشارات الكهربائية، بل تعمل على نقل الإشارات الكيميائية من خلية عصبية إلى خلية عصبية أخرى أو إلى خلية عضلية أو غدية. يتم نقل الإشارات الكيميائية عن طريق الناقل العصبي (الموصل العصبي) الذي ينتقل من خلية عصبية إلى خلية عصبية أخرى أو إلى خلية عضلية أو غدية. الناقل العصبي يشبه صبغة في الناقل.

- **Neurotransmitter** is a molecule released from a synaptic vesicle to excite or inhibit another neuron, muscle fiber, or gland cell.

- Many neurons have two or even three types of neurotransmitters, each with different effects on the postsynaptic cell.

لأنه في الخلايا العصبية...



CLASSIFICATION OF NEURONS

ص ب عدد الزوائد التي تنطلق من جسم الخلية → التصنيف البنيوي

1. **Structural Classification** (according to the number of processes extending from the cell body).

ص ب اتجاه انتقال الإشارة العصبية بالنسبة لـ CNS → التصنيف الوظيفي

2. **Functional Classification** (according to the direction in which the nerve impulse (action potential) is conveyed with respect to the CNS).

1. Why can't neurons divide like other cells?
- Because they are highly specialized and lose their ability to undergo mitosis after maturity.
2. What's the importance of Neuroglia if they don't conduct impulses?
- They maintain the environment around neurons, nourish them, and protect them from damage.
3. Why are dendrites compared to tree branches?
- Because they branch out extensively to receive signals from many other neurons.
4. What makes a neuron a "functional unit" of the nervous system?
- It's the only cell capable of generating and transmitting nerve impulses.
-

1. Which of the following cells can divide throughout life?
- A. Neurons
 - B. Neuroglia
 - C. Both
 - D. Neither

2. The structure responsible for receiving signals in a neuron is the:
- A. Axon
 - B. Dendrite
 - C. Cell body
 - D. Axon terminal

3. The site of communication between two neurons is called:
- A. Nucleus
 - B. Synapse
 - C. Axon hillock
 - D. Myelin sheath

4. Which neuron type is most common in the brain and spinal cord?
- A. Unipolar
 - B. Bipolar
 - C. Multipolar
 - D. Pseudounipolar

5. Which functional class of neurons carries information from receptors to the CNS?
- A. Motor (Efferent)
 - B. Interneuron
 - C. Sensory (Afferent)
 - D. Connector neuron

	1	2	3	4	5
Answers:	B	B	B	C	C

STRUCTURAL CLASSIFICATION

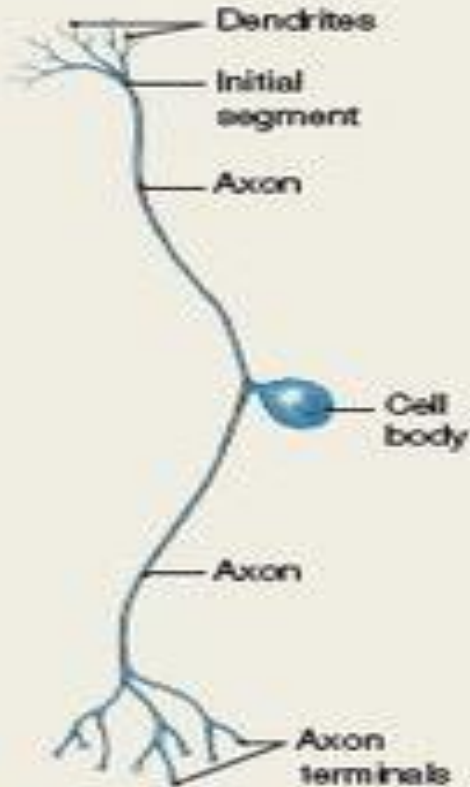
b Bipolar neuron

Bipolar neurons have two processes separated by the cell body.



c Unipolar neuron

Unipolar neurons have a single elongated process, with the cell body located off to the side.



d Multipolar neuron

Multipolar neurons have more than two processes; there is a single axon and multiple dendrites.



مجم الخلايا بالانقسام
وحدود من جهة
تفرع من جهة أخرى

مجم الخلايا
منبسطة
تفرع واحد
بفصل فرعي

خلية جسمها مركزي
عدة تفرعات شجرية ومحور
واحد.

كثيرة

STRUCTURAL CLASSIFICATION

بب تترك بالوظيفة لا حسب: نقل الإشارات العصبية [أي أنها في أنواع]

- A **multipolar neuron** has many processes extending from the cell body, a **bipolar neuron** has two, and a **unipolar neuron** has one.

أشتر أنواع منش بالجسم

- ① ■ **Multipolar neurons** have several dendrites and one axon (i.e., neurons in the brain and spinal cord). They are found as motor neurons (all) and interneurons (many).

← داخل CNS بين neurons
ترتبط الخلايا ببعضها لتكوين العصبون

ووظيفتها: نقل كـ motor neurons كلها أو
interneurons (بعضها فقط)
يعني نقل الإشارات من الـ CNS
للعضلات أو بين الخلايا العصبية
داخل الجهاز العصبي المركزي.

STRUCTURAL CLASSIFICATION

2 ■ **Bipolar neurons** have one main dendrite and one axon (i.e., neurons in the retina of the eye, the inner ear, and the olfactory area of the brain). Some of them are found as sensory neurons.

الأنسجة فقط
موجودة بأماكن محددة
جزء
المنطقة الحسية

الزوائد التي فيها موجبة، يعني ال Dendrites

أما Axon فله امتداد معين

3 ■ **Unipolar neurons** have dendrites and one axon that are fused together to form a continuous process that emerges from the cell body. They are found as most of the body's sensory neurons.

Type of Neuron	Number of Processes	Main Locations	Function
Multipolar	Several dendrites + one axon	Brain, spinal cord	Motor neurons & interneurons
Bipolar	One dendrite + one axon	Retina, inner ear, olfactory area	Sensory neurons (special senses)
Unipolar (Pseudounipolar)	Single fused process (dendrite + axon)	Sensory ganglia of spinal nerves	Sensory neurons (general senses)

- Why are multipolar neurons the most common type in the CNS?
→ Because most functions in the brain and spinal cord require complex integration between many neurons.
- Why are bipolar neurons limited to special senses?
→ They transmit very specific, localized sensory information like vision and smell that doesn't need multiple dendritic inputs.
- What structural feature makes unipolar neurons efficient for sensory transmission?
→ The fused process allows faster signal conduction from receptors to the spinal cord without delay through the cell body.

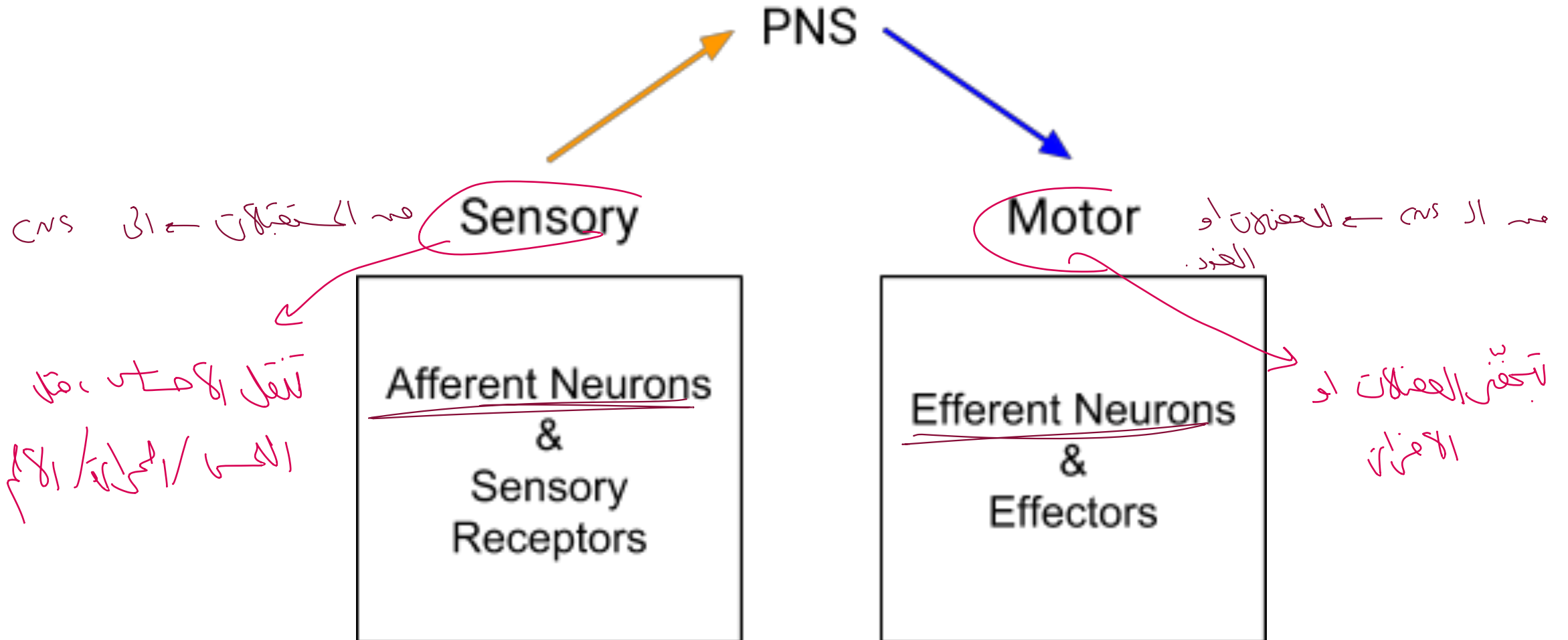
- Which type of neuron has several dendrites and one axon?
A. Bipolar
B. Multipolar
C. Unipolar
D. Sensory

- Bipolar neurons are commonly found in:
A. Spinal cord
B. Brain cortex
C. Retina and inner ear
D. Skeletal muscles

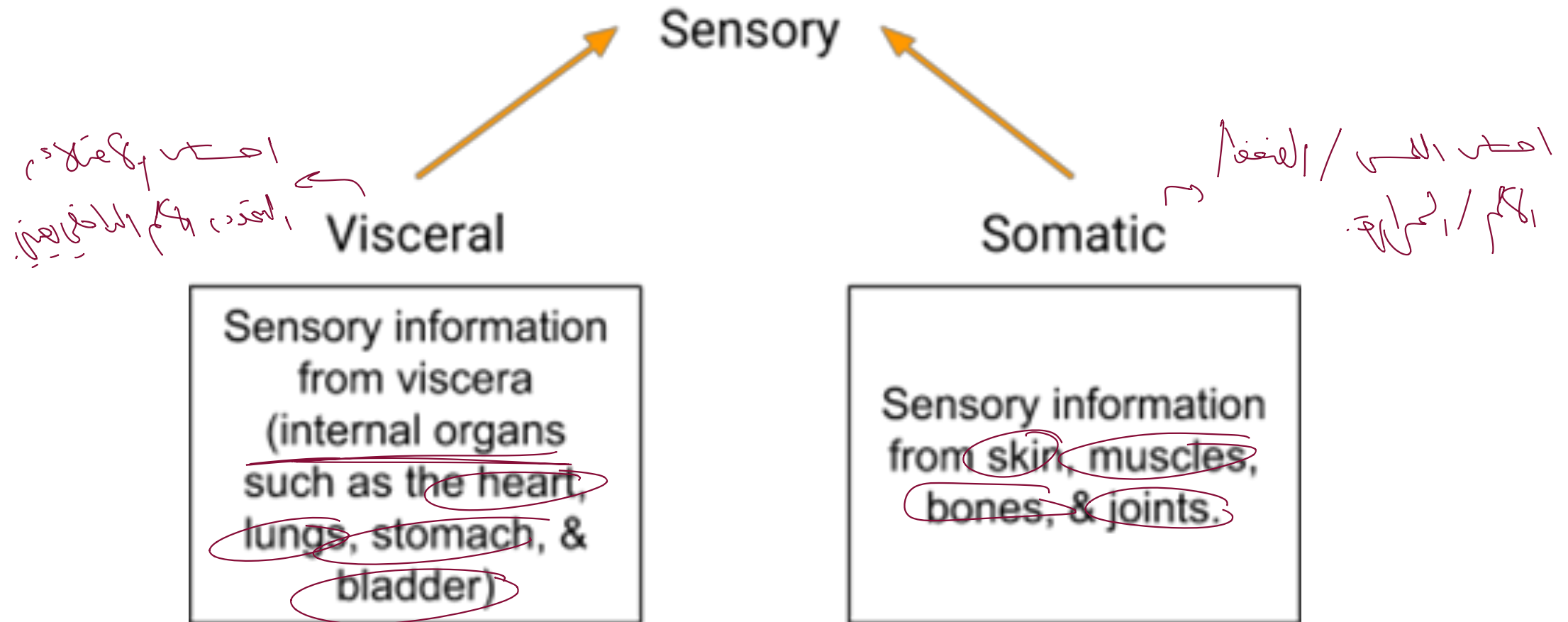
- The majority of sensory neurons in the body are:
A. Unipolar
B. Bipolar
C. Multipolar
D. Interneurons

	1	2	3
Answers:	B	C	A

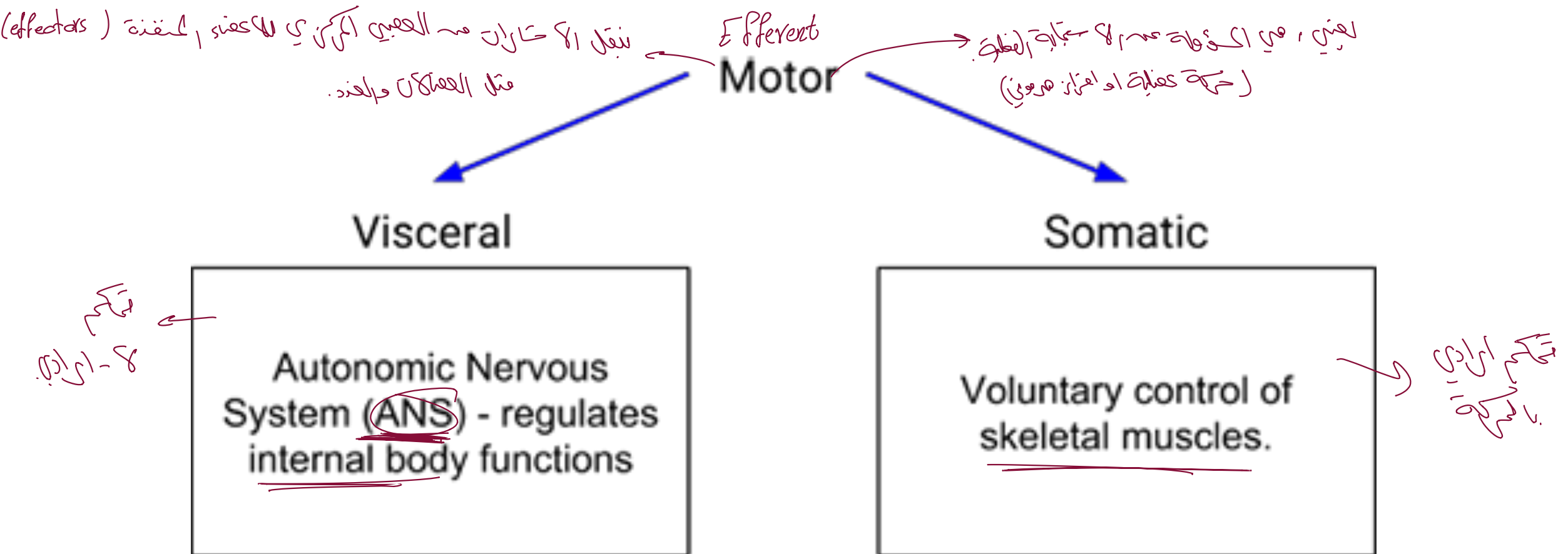
FUNCTIONAL CLASSIFICATION



SENSORY OR AFFERENT NEURONS



MOTOR OR EFFERENT NEURONS



INTERNEURONS OR ASSOCIATION NEURONS

Sends signals to motor system

Integrates information from sensory systems

Cell body

Type of Neuron	Direction of Impulse	Main Location	Function	Example
Sensory (Afferent)	From receptors → CNS	PNS	Detects internal & external stimuli	Touch, temperature, pain
Motor (Efferent)	From CNS → effectors	PNS	Causes muscle contraction or gland secretion	Skeletal muscle movement
Interneurons (Association)	Within CNS	CNS (brain & spinal cord)	Integrate & process information	Reflex pathways

بال CNS
موجودة بس

سواء في الدماغ أو في الحبل الشوكي
توجد في الجهاز العصبي المركزي

الرافعة
الرافعة

ad neurons بتصرف حسب
 اتجاه انتقال النبضة العصبية
 بالنسبة لـ CNS للأنواع
 الرئيسية:

FUNCTIONAL CLASSIFICATION

المستقبل = نبضة مُستقبل حسي
Sensory Receptor.

هي الخلايا المُؤدية من استقبال المثيرات (stimuli) من البيئة الداخلية أو الخارجية.

① **Sensory or afferent neurons (most are unipolar):** appropriate stimulus activates a sensory receptor; the sensory neuron forms an action potential in its axon and the action potential is conveyed into the CNS through cranial or spinal nerves. Most sensory neurons are unipolar in structure.

unipolar = لأنها تمتلك تفرع واحد
 لنقل نقل الإشارات بسرعة من المستقبل
 إلى CNS.

تتميز النبضة من خلال ذلك حتى
 توصل للدماغ أو العضلات.

هذا المستقبل ينشئ نبضة حسية Action potential تنقلها
 طول المحور العصبي Axon باتجاه CNS.

② **Motor or efferent neurons (most are multipolar):** convey action potentials (commands) away from the CNS to effectors (muscles and glands) through cranial or spinal nerves.

أغلبها multipolar = لأنها تمتلك عدة Dendrites
 لكي تستقبل أوامر من عدة خلايا داخل CNS.

FUNCTIONAL CLASSIFICATION

3 ■ Interneurons or association neurons (most are multipolar):

- They are located within the CNS (brain and spinal cord) between sensory and motor neurons.
- They integrate the incoming sensory information from sensory neurons (transmit action potential from one neuron to another) and then elicit a motor response by activating the appropriate motor neurons.

الوظيفة: الربط بين الخلايا الحسية والخلايا الحركية

* يعني: تستقبل المعلومات من الخلايا الحسية → تنقلها → تنقلها للخلايا الحركية المناسبة.

- Main functions are thinking, memory, decision making.

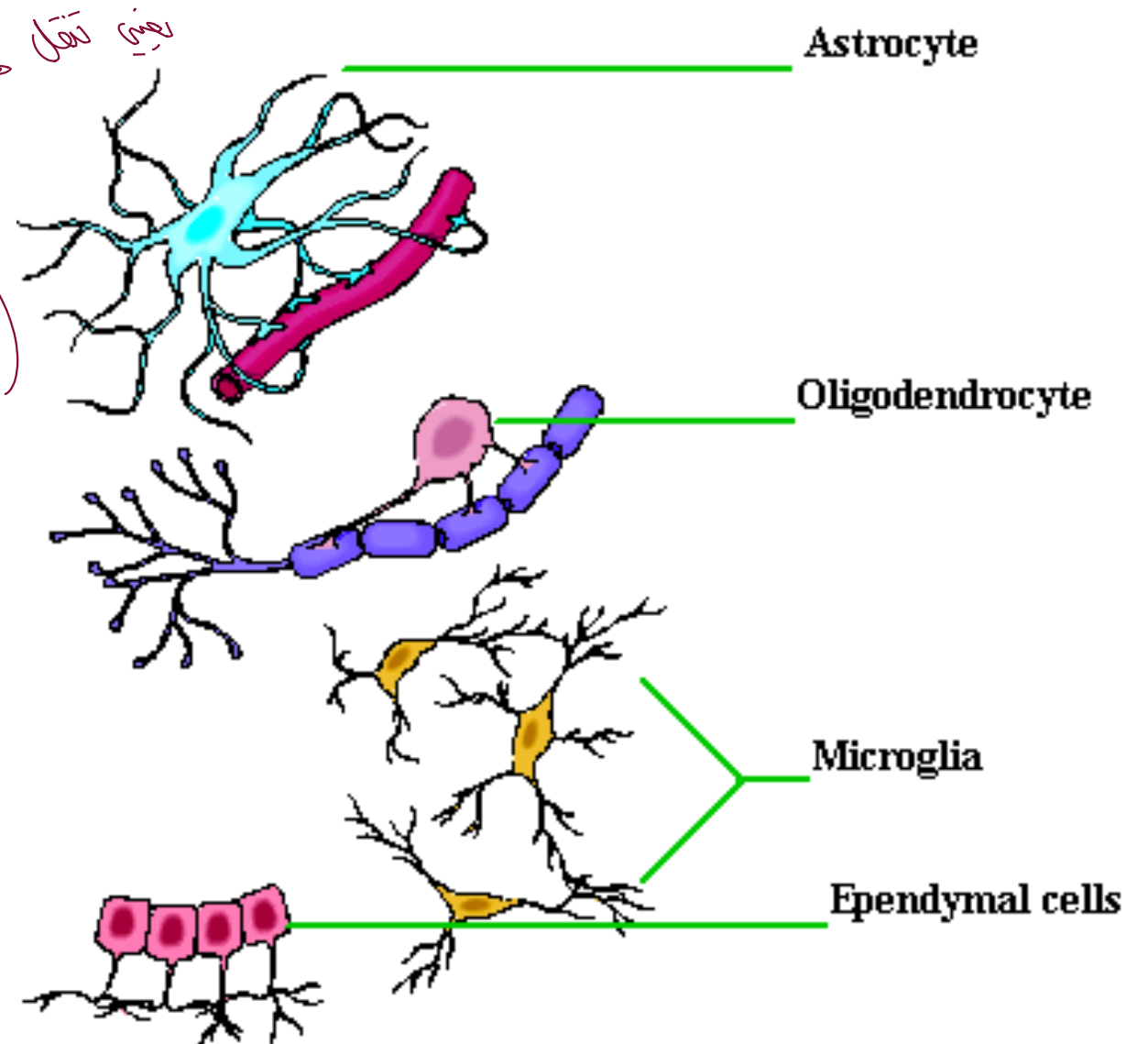
NEUROGLIA

الخلايا الناعية العصبية
تحتوي على: خلايا الدم / الخلايا العصبية
للنوترونات

Neuroglial Cells of the CNS

- In contrast to neurons, **neuroglia do not generate or propagate action potentials**, and they can **multiply and divide** in the mature nervous system. (Action potential. ما يتولد)

- Neuroglia of the CNS can be classified into four types: **astrocytes, oligodendrocytes, microglial cells, and ependymal cells.**



ASTROCYTES

1. **Support neurons.**

لبن شكل حاجز بين الدماغ والدم - جرحه (BBB)

2. **Isolate neurons** of the CNS from various potentially **harmful substances** in blood.

3. **Regulate** the growth, migration, and interconnection among **neurons** in the brain.

ضد نمو لنقل الخلايا العصبية.

4. **Maintain** the appropriate chemical environment for the generation of **nerve impulses**.

5. Play a role in **learning and memory** by influencing the formation of neural synapses.

من خلال التأثير على تكوين synapses

Feature	Sensory (Afferent)	Motor (Efferent)	Interneuron (Association)	Neuroglia
Direction of impulse	Toward CNS	Away from CNS	Within CNS	None
Function	Detect stimuli	Execute response	Integrate & process info	Support & protect neurons
Structure	Mostly Unipolar	Mostly Multipolar	Multipolar	Non-neuronal
Location	PNS → CNS	CNS → Effectors	CNS only	CNS & PNS
Ability to divide	✗ No	✗ No	✗ No	✓ Yes
Example	Pain receptor neuron	Motor neuron to muscle	Reflex connector neuron	Astrocyte

- Why are sensory neurons mostly unipolar?
→ To allow faster transmission of impulses from receptors to the CNS with minimal delay.
- Why are motor neurons multipolar?
→ Because they need to integrate multiple inputs before sending a single output to effectors.
- Why can neuroglia divide but neurons cannot?
→ Neuroglia are support cells without specialized structures for conduction, so they retain mitotic ability.
- How do astrocytes help maintain the brain environment?
→ They regulate ion balance, nutrient supply, and form part of the blood-brain barrier.

- Which of the following neurons carry impulses toward the CNS?
A. Motor neurons
B. Sensory neurons
C. Interneurons
D. Association neurons

- Most sensory neurons are:
A. Multipolar
B. Bipolar
C. Unipolar
D. Pseudobipolar

- Interneurons are found mainly in:
A. Brain and spinal cord
B. Muscles
C. Glands
D. Sensory organs

- Which neuroglial cell forms the blood-brain barrier?
A. Microglia
B. Astrocytes
C. Oligodendrocytes
D. Ependymal cells

Answers:

1

2

3

4

B

C

A

B

خلايا قليلة العدد

خليّة عروسة من هاليف فكم تكلّف عة محاور
عصبة متلفة.

OLIGODENDROCYTES

- They are forming and maintaining the myelin sheath which increases the speed of nerve impulse conduction around CNS axons. (containing interneurons)

سرعة انتقال إشارات
العصب.

تعمل ك خلايا مناعية داخل ال CNS

MICROGLIA

لصني كمنه رغبتيها
المنفعة واحد الدعاي

*Function:

17

They remove cellular debris formed during normal development of the nervous system and phagocytize microbes and damaged nervous tissue.

الخلايا

EPENDYMAL CELLS

Function:

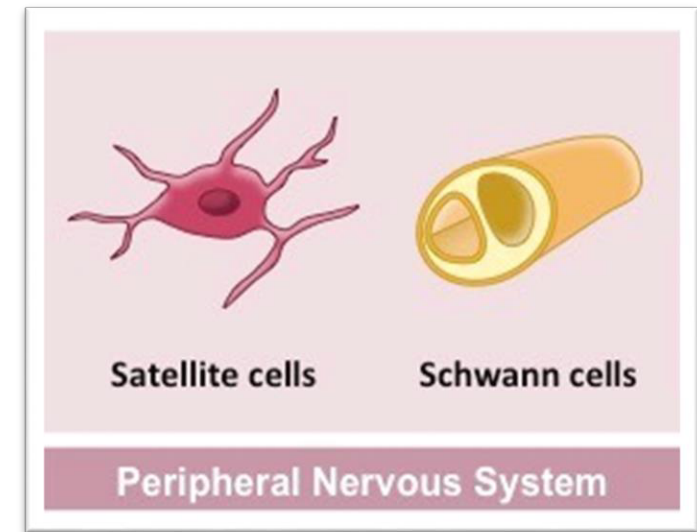
إنتاج

تنظيم

الخلايا الداعية العصبية

- They produce and assist in the circulation of cerebrospinal fluid.

NEUROGLIA OF THE PNS



- The two types of glial cells in the PNS are **Schwann cells** and **Satellite cells.**

كل خلية شوان تتغلف محور وانه بس
عكس ال oligodendrocyte

SCHWANN CELLS

- They form the myelin sheath around axons and participate in axon regeneration. (containing sensory and motor neurons).

تساعد بخلية تجديد المحاور العصبية اذا
لقد تضررت

SATELLITE CELLS

- They provide structural support and regulate the exchanges of materials between neuronal cell bodies and interstitial fluid.

التي تملك الخلية
المحيط بها

Nervous System	Cell Type	Main Function	Key Features
CNS	Astrocytes	Support neurons, regulate ions, form blood-brain barrier, aid in learning & memory	Star-shaped, most numerous
CNS	Oligodendrocytes	Form & maintain myelin sheath around CNS axons	One cell → many axons
CNS	Microglia	Remove debris, phagocytize microbes & damaged tissue	Immune defense of CNS
CNS	Ependymal Cells	Produce & circulate cerebrospinal fluid (CSF)	Line ventricles & spinal canal
PNS	Schwann Cells	Form myelin sheath around PNS axons, aid regeneration	One cell → one axon
PNS	Satellite Cells	Provide structural support & regulate exchange of materials	Surround neuron cell bodies in ganglia



THANK YOU

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