

وسهلا

أهلا



الأستاذ الدكتور يوسف حسين

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دكتورة من جامعة كولونيا المانيا

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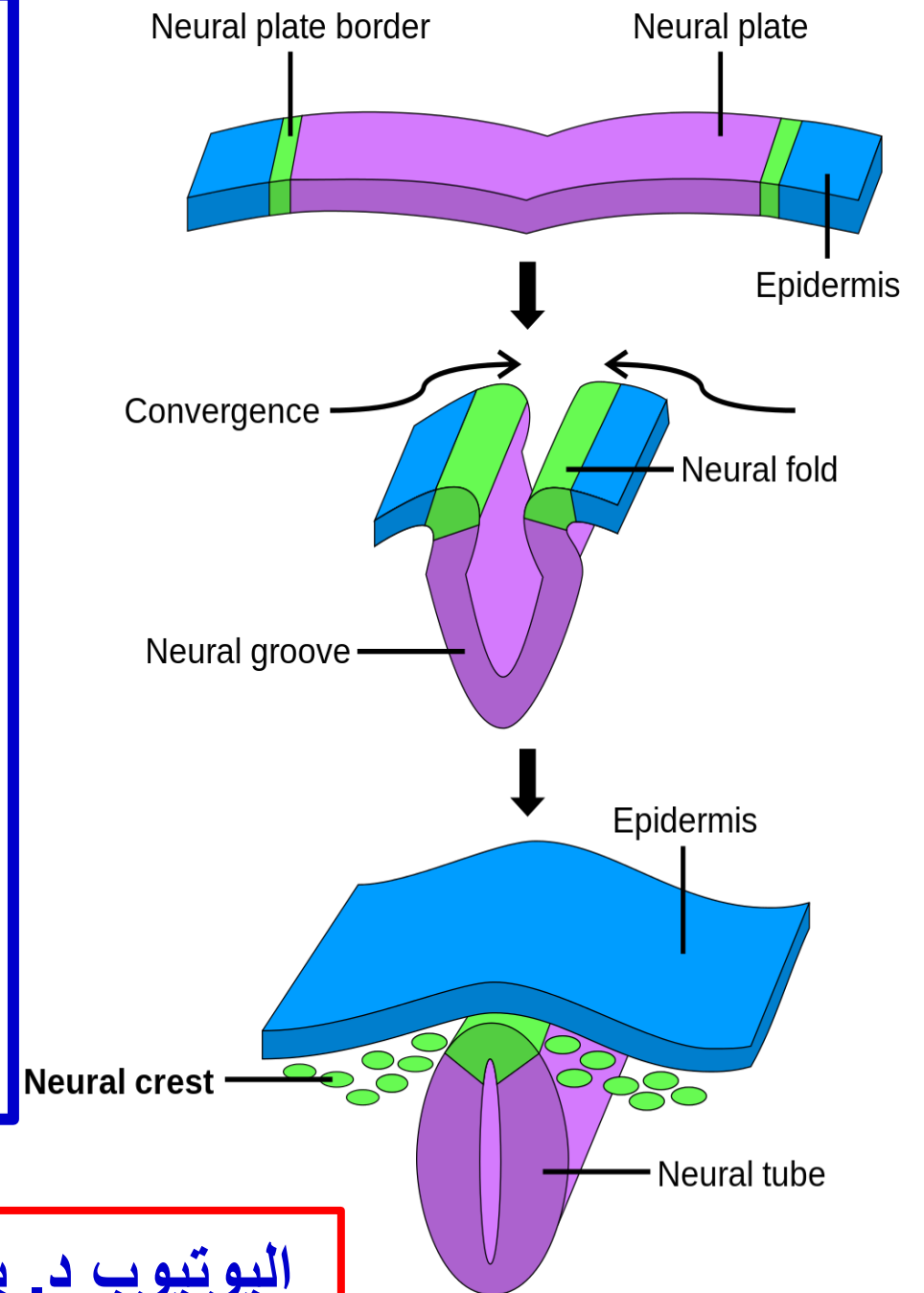
Development of CNS

Central nervous system

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Development of the neural tube:

- The neural tube develops as neural plate from the **ectoderm** dorsal to the notochord.
- A **neural pit** that forming the **neural groove**.
- The edges of the neural groove fused forming the **neural tube** that later on separated from the ectoderm.
- Neural tube lies opposite developed somites:
 - a- The part **cranial to the 4th somite** is dilated and forms the **brain**.
 - b- The part **caudal to the 4th somite** remains narrow and forms **the spinal cord**.



Development of Spinal cord

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** Cyto-differentiation of the neural tube:

(I) **Ependymal layer:** the most inner layer which contains 2 types of cells;

a- **Ependymal cells** line the cavity of the neural tube.

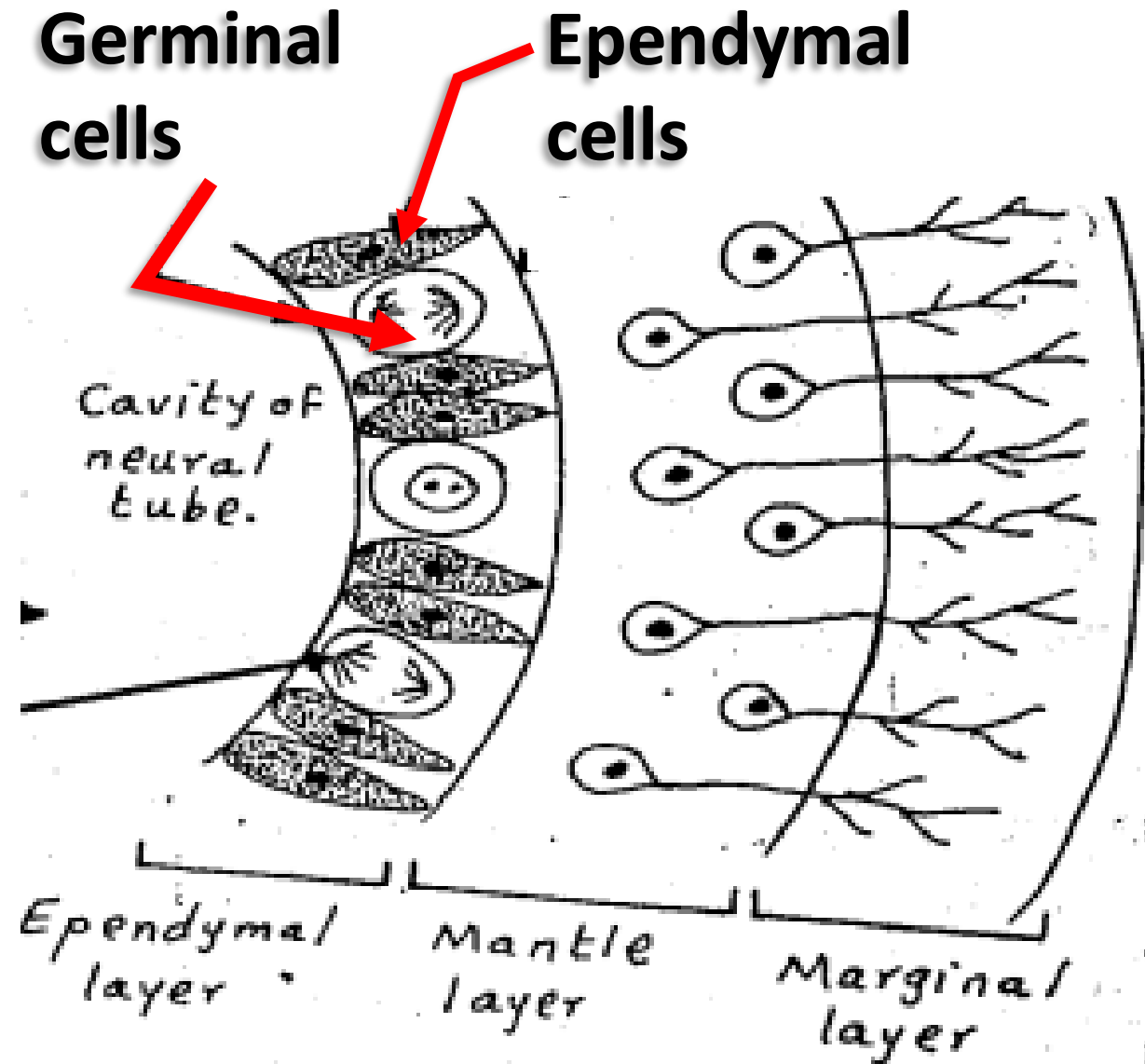
b- **Germinal cells** divide repeatedly and migrated peripherally to form the mantle layer.

(II) **Mantle layer:** the middle layer; It forms the **gray matter** of the spinal cord and is formed of two types of cells:

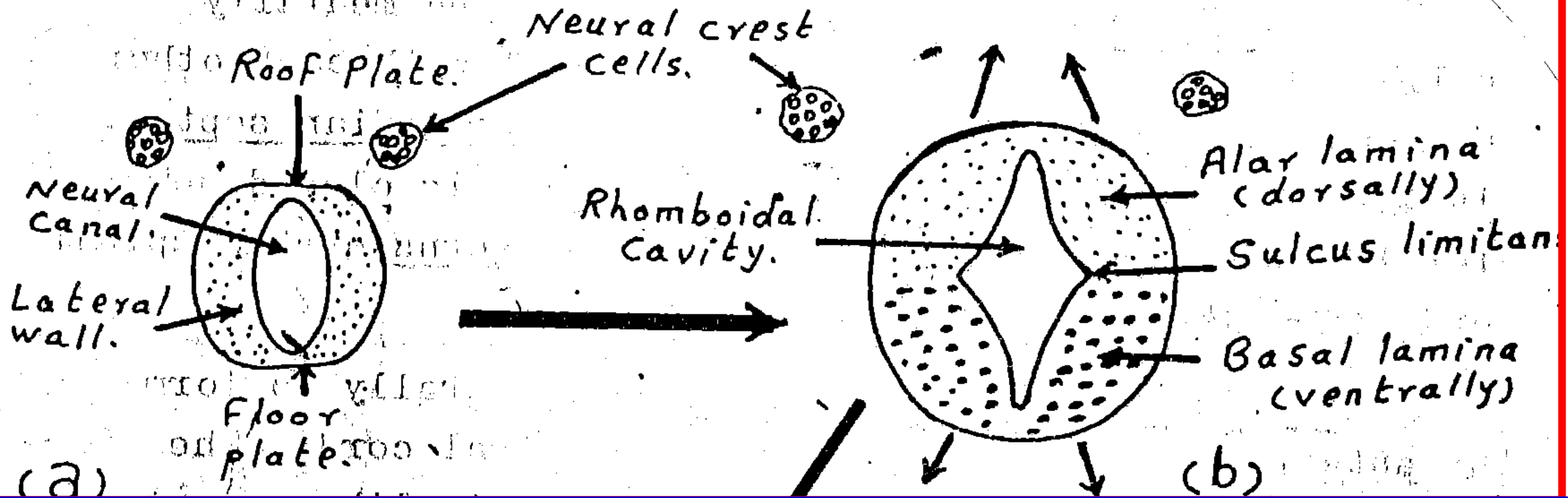
a- **Neuroblasts** (nerve cells or neurons), the axons of these cells extend to the marginal layer.

b- **Neuroglial cells** (supporting cells).

(III) **Marginal layer:** the outer layer containing ascending and descending tracts (**white matter** of the spinal cord).



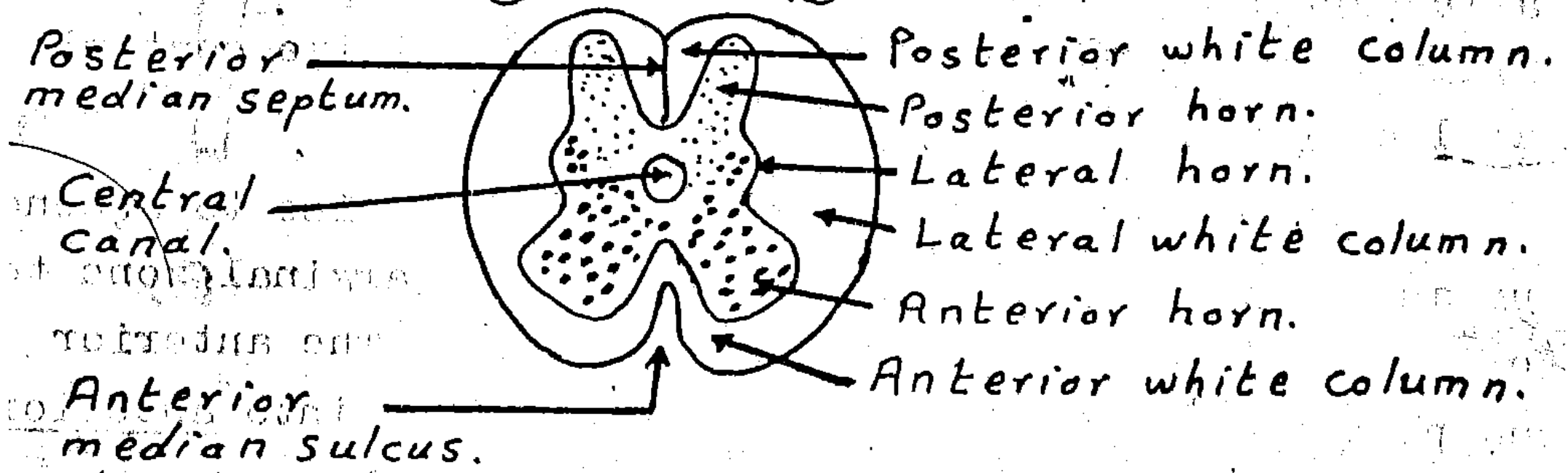
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** At first, the **neural tube** has thick lateral wall, thin roof plate and floor plate, and a narrow slit-like lumen.

- **The ventral and dorsal parts** of the lateral wall become thick by proliferation of the cells in the mantle zone. As a result, it is divided by lateral sulcus called sulcus limitans into ventral part (**basal lamina**) and dorsal part (**alar lamina**) and the cavity becomes rhomboidal in shape:

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A- Ventral parts: contain motor cells, form the anterior and the lateral horns of the spinal cord.

- The **anterior horns** are found in all segments.
- The **lateral horns** are found in;
 - 1) All the thoracic and upper 2-3 lumbar segments (sympathetic).
 - 2) In the 2nd, 3rd and 4th sacral segments (parasympathetic).

B- Dorsal parts: contain the sensory cells, form the posterior horns of the spinal cord

C- The cavity becomes reduced in size (narrow) to form the central canal.

D- Marginal layer: the outer layer containing ascending and descending tracts (**white matter** of the spinal cord, anterior, lateral and posterior columns).

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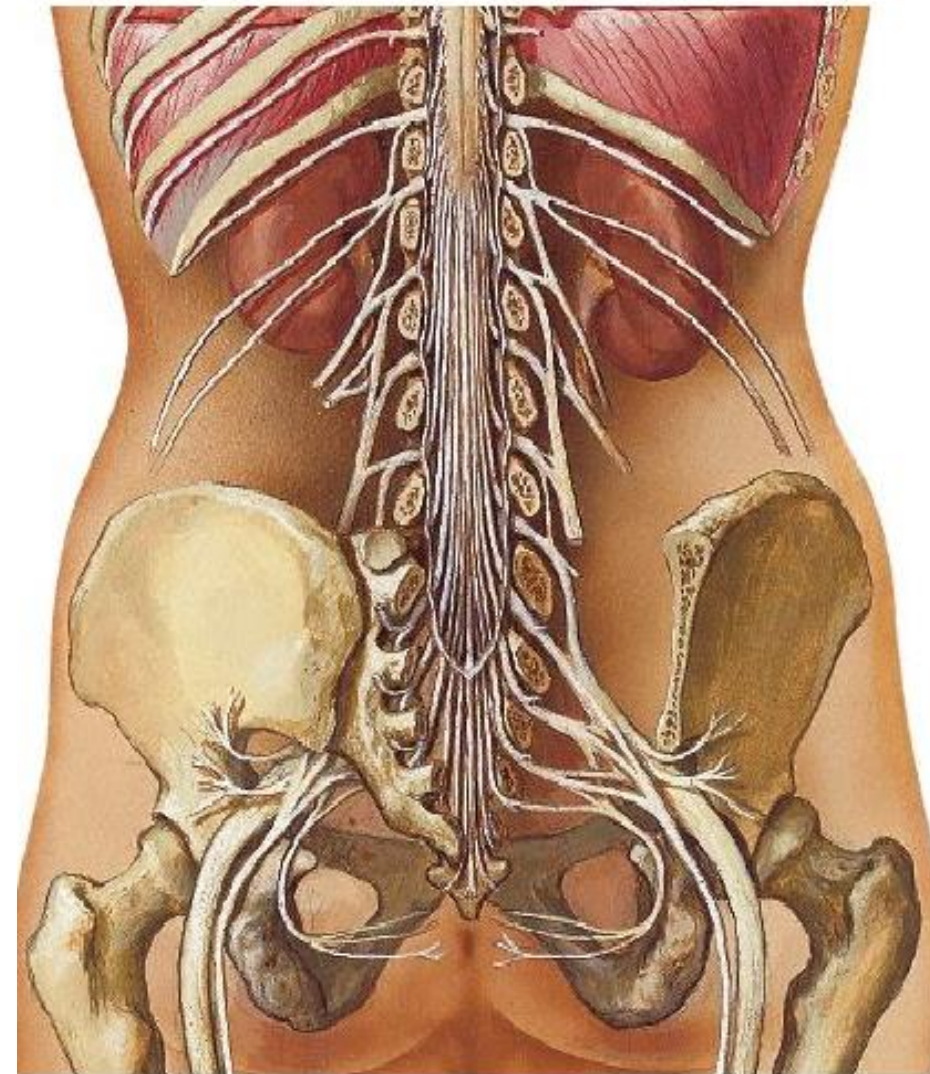
▪ **Termination of the spinal cord varies with the age:**

1- **At the 3rd month of intrauterine life, tip of coccyx.**

2- **At birth, intervertebral disc of L3/L4.**

3- **Adult; at the level of intervertebral disc of L1/L2.**

- Below this level, vertebral canal contains **roots** of lumbar, sacral, and coccygeal nerves around filum terminale which form a bundle called **Cauda Equina (L2 - C1)**
- The **lower nerve roots are longer and more oblique** because the spinal cord is shorter than the vertebral canal



- **Congenital anomalies of the spinal cord**

1- Spina bifida: the cord is exposed directly to the skin due to failure of fusion of neural arch of vertebra.

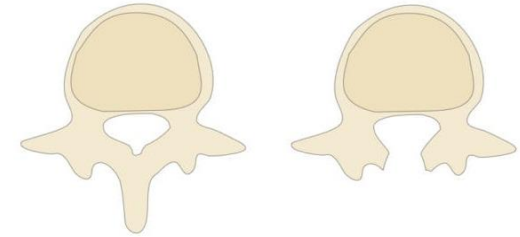
**** Types of spina bifida:**

a- Spina bifida occulta: bifid spines of the vertebra with normal spinal cord.

b- Meningocele; bulge of the meninges through the spina bifida.

c- Meningo-myelocele; bulge of the meninges and spinal cord through the spina bifida.

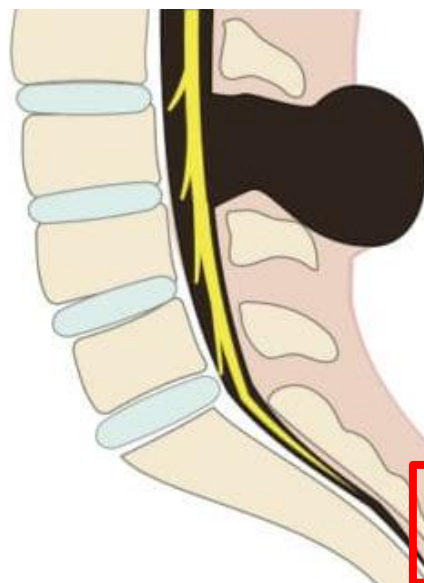
d- Myelocele; the spinal cord is exposed directly to the spina bifida.



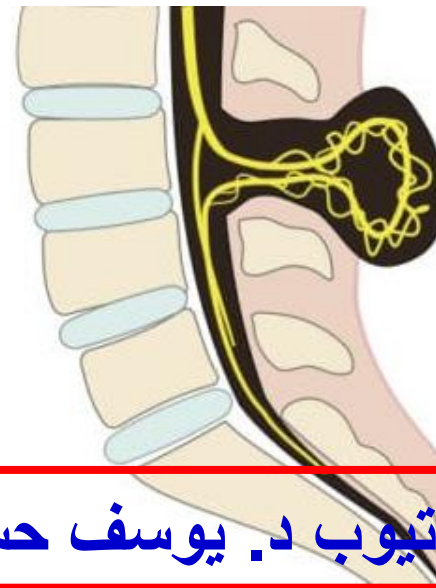
Spina bifida occulta



Meningocele



Meningomyelocele



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Myelocele



▪ **Spina bifida occulta**

- It is discovered **accidentally** there is tuft of hair, dimple, sinus, hemangioma, hyperpigmentation, lipoma or scar
- **Causes increase the risk** are genetic, nutritional (insufficient of vit B complex, folic acid during pregnancy), environmental, obesity woman, diabetes
- **Main symptoms:**
 - Urinary incontinence
 - Bowel incontinence
 - Lack of sensation
 - Weakness or paralysis in the lower limb
- **Causes of tuft of hair in spina bifida occulta**

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A- Abnormal invagination of ectoderm into posterior closure of the neural tube.

B- There is a problem with Cell differentiation/ migration that the skin develops hair like scalp since the appropriate hair growth inhibitory factors are not present

Spina bifida occulta

- Causes of tuft of hair in spina bifida occulta

A- abnormal invagination of ectoderm into the posterior closure of the neural tube.

B- There is a problem with Cell differentiation or migration that the skin over the area of the incomplete vertebrae develops hair like scalp since the appropriate hair growth inhibitory factors are not present

- It is discovered accidentally there is tuft of hair, dimple, sinus, hemangioma, hyperpigmentation, lipoma or scar**
- causes genetic, nutritional insufficient of b complex, folic acid during pregnancy, environmental, obesity woman, diabetes increase the risk,**
- Weakness or paralysis in the lower limb**
- Urinary incontinence**
- Bowel incontinence**
- Lack of sensation in the skin**



Rachischisis: spinal
cord

Cranioschisis: brain

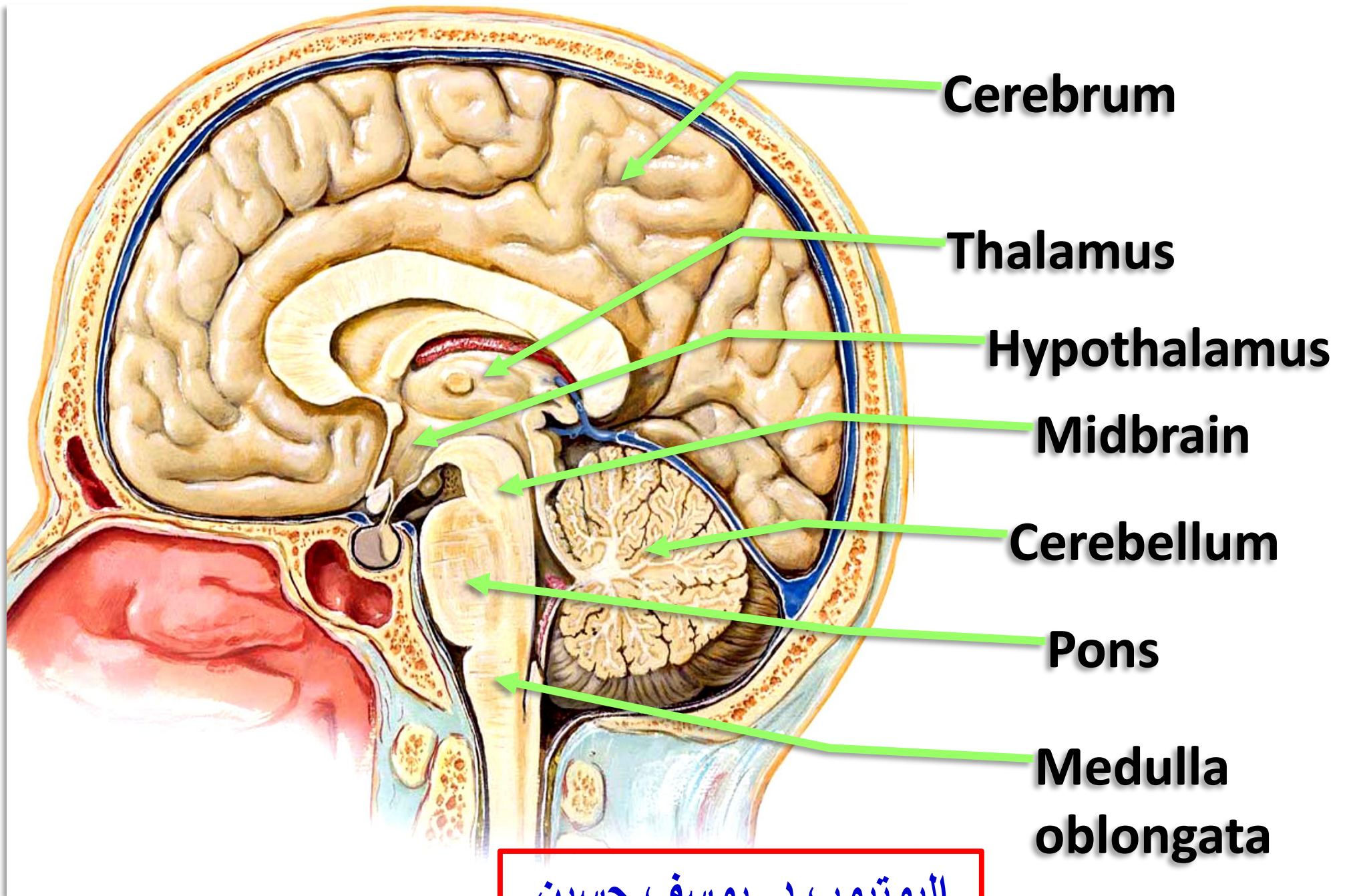
Craniorachischisis:
brain & cord

Craniorachischisis: Failure of closure of the neural tube leading to longitudinal cleft in the back of the head and vertebral column

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Development of Brain

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• DEVELOPMENT OF THE BRAIN

- The brain develops from the part of the neural tube cranial to the 4th somite.
- This part shows 3 dilatations, forebrain, midbrain and hindbrain vesicles.

• Differentiation of the brain vesicle

1- Forebrain vesicle (prosencephalon): divided into 2 parts:

1- A median part (**diencephalon**) gives rise to;

- Thalamus and 3rd ventricle .
- Epithalamus.
- Hypothalamus.
- Metathalamus.

2- Two lateral parts (**telencephalon**) gives rise cerebrum and lateral ventricles.

2- Midbrain vesicle (mesencephalon) Gives rise to the midbrain.

3- Hindbrain vesicle (Rhombencephalon):divided into 2 parts:

- Cranial part or **metencephalon** gives pons and cerebellum and 4th ventricle.
- Caudal part or **myelencephalon** gives medulla oblongata.

Meningocele

herniation of a part of
the meninges

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For Information,
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Meningoencephalocele



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- **Meningoencephalocele**

herniation of a part of the brain and its covering meninges.

- **Meningohydroencephalo**

cele: herniation of the meninges and part of the brain and its ventricle containing CSF

- **Anencephaly:**

failure of development of greater part of the brain and vault of the skull due to failure of cephalic part of the neural tube to close

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- **Hydrocephalus**
excessive
accumulation of
C.S.F in the
ventricular system
due to closure in the
CSF circulation

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- **Microcephaly**

small skull and

cerebral

hemisphere



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- **Cyclopia** one cerebral hemisphere, one ventricle and one median eye

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DERIVATIVES OF THE NEURAL CRESTS

➤ A special neuro-ectodermal cells dorsolateral to the neural tube.

1- Sensory Cells of the **para-sympathetic ganglia** ((Ciliary of 3rd, pterygopalatine and submandibular of 7th, Otic of 9th and enteric ganglia of 10th cranial nerves))

2- Sensory Cells of the **sympathetic ganglia**

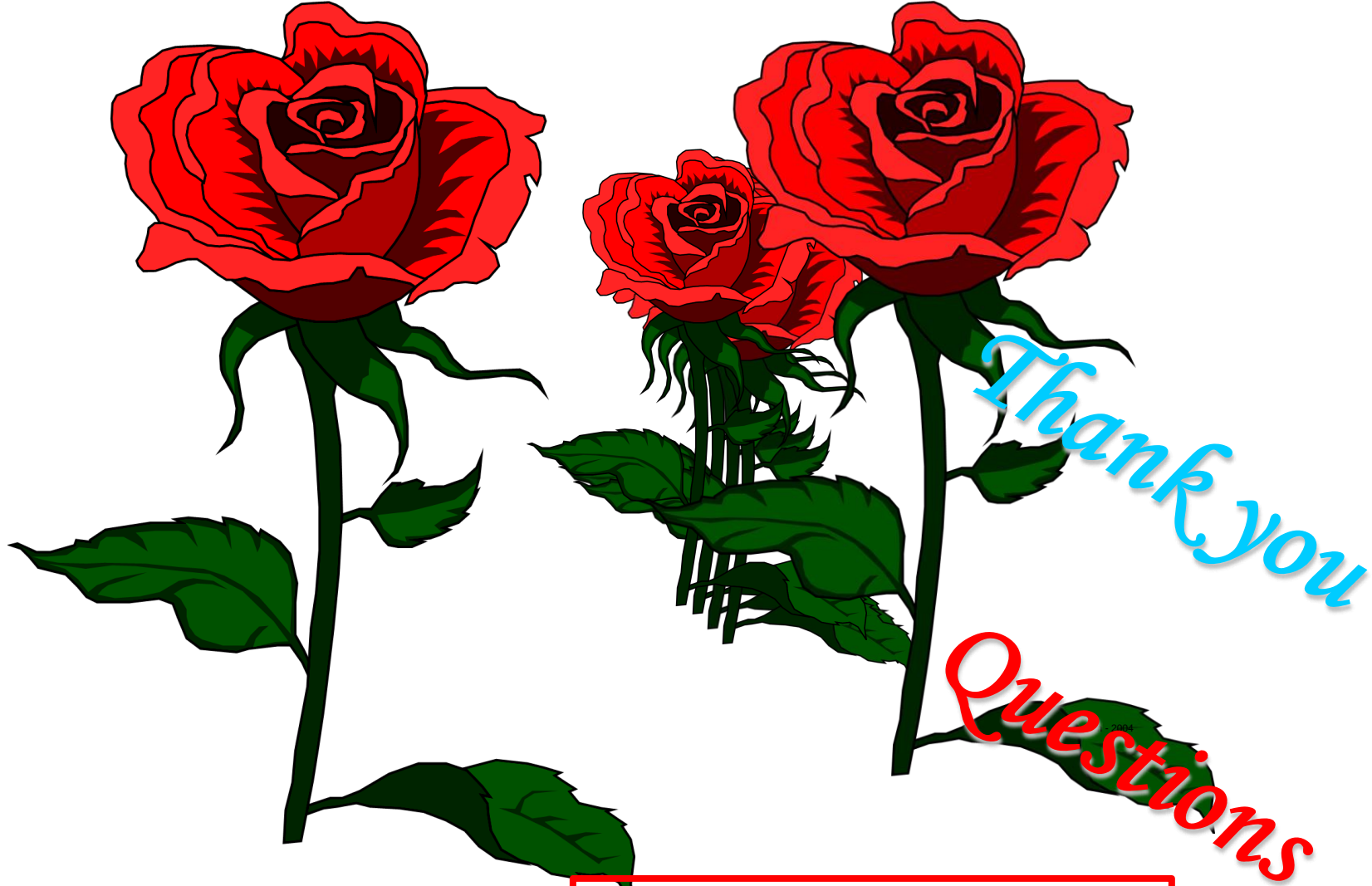
3- Sensory Cells of the **dorsal root ganglia of the spinal nerves**

4- **Pia and arachnoid matters** of the meninges (dura matter mesodermal in origin).

5- **Schwan cells** that form the myelin sheath

6- **Chromaffin cells** of the suprarenal medulla

7- **Pigment cells** in the skin, iris and retina.



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