# THE PERIPHERAL NERVOUS SYSTEM

- The peripheral nervous system consists of: (A) cranial and (B) spinal nerves.

**A. Cranial nerves :**

- They arise from the brain and they are all paired. Except for the first four pairs of cranial nerves, the rest arise from the medulla oblongata.
- There are 10 pairs of cranial nerves in anamniotes and snakes, but 12 pairs in amniotes.
- Nerves that connect the receptor organs to the CNS are **sensory** or **afferent nerves,** while those which connect the effectors like **muscles** and **glands** to the CNS are **motor** or **efferent nerves.**
- Most nerves are mixed with both sensory and motor **nerve fibres. The 12** pairs of cranial nerves are :
- **I. Olfactory nerves: This is a sensory nerve** and innervates the olfactory lobe.
- **II. Optic nerve: Sensory nerve.** It arises as a tract of nerve fibres from the retina of the eye. The fibres of the two sides cross on the ventral side of diencephalons and form **optic chiasma.**
- **III. Oculomotor nerve: Motor nerve.** It arises from crura cerebri mid brain and innervates to **anterior, superior and inferior recti muscles** and the **inferior oblique muscles of the eye ball.**
- **IV. Pathetic or Trochlear nerve** : Motor nerve. This is a thin nerve arising **from the** dorsolateral side of the mid brain and innervates the **superior oblique muscle of the** eye ball.
- **V. Trigeminal:** It orginates from **Gasserian ganglion** on the lateral side of medulla. This is a **mixed nerve. It** has three branches –

1. **Opthalmic superficiailis :** It receives the sensory impulses from conjunctiva, iris, cornea, ciliary body, lacrimal glands and upper eyelids of the eye. It also receives the sensory impulses from the epithelium of nasal sac. It is a sensory nerve.
2. **Mandibularis :** It is a mixed nerve. It receives the sensory impulses from soft palate, teeth of the upper jaw, vibrissae, lower eye lids, upper lip, sides of snout and mucosa of nasal sac. It takes the motor impulses to lacrimal glands.
3. **Maxillary** : It is a mixed nerve. It receives the sensory impulses from the skin of temporal region, teeth of lower jaw, external ears, lower lip and anterior region of tongue. It takes motor impulses to muscles of lower jaw, sublingual and submaxillary salivary glands.

- **VI. Abducens : Motor nerve. Enters** the orbit and goes to the **posterior rectus muscle** of the eye ball and nictitating membrane.
- **VII. Facial nerve - Mixed Nerve, Originates from Pons** - It has 3 branches
  1. **Palatine** : connects to the roof of buccal cavity.
  2. **Chorda tympani**: It is a **sensory nerve**. It receives the sensory impulses from the taste buds present at the anterior part of the tongue.
  3. **Hyomandibular**: It is a **motor nerve**. They arise from internal ear and end in of lower jaw, neck, pinna, face salivary glands and hyoid.
- **VIII. Auditory-Sensory nerves.** These are sensory nerves. They arise from the internal ear and end in the medulla. They receive sensory impulses from internal ear. Each nerve devides into two branches.
  1. **Vestibular** brings impulses from utriculus, sacculus and semicircular canals.
  2. **Cochlear** from cochlea.
- **IX. Glossopharyngeal: Mixed nerves,** they originate from medulla.

  **i) Lingual**: It goes to the tongue, salivary glands and pharynx.

  **ii) pharyngal**: **It** goes to pharynx and salivary glands.
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  **i) Lingual**: It goes to the tongue, salivary glands and pharynx.
  **ii) pharyngal**: **It** goes to pharynx and salivary glands.
  **2. Cardiac**: It is a **motor** nerve**.** It takes the motor impulses to the muscles of heart.
  **5**. **Pneumogastric** : It is a mixed nerve. It receives the sensory impulses from lungs, oesophagus and stomach, and takes the motor impulses to the muscles of lungs, Oesophagus and stomach.
- **XL Spinal accessory:** These are **motor** nerves. Originate in medulla. Banches of spinal accessory take the motor impulses to the muscles of pharynx, larynx, neck and shoulders.
- **XII**. **Hypoglossal nerve : Motor nerve.** Originates from medulla and innervates the muscles of tongue and hyoid apparatus.
- The Cranial nerves I, II and VIII are Sensory, III, IV, V, XI & XII are motor while V, VII, IX & X are mixed.

| Name with Brain Main branches | Origin from | Distribution | Nature |
|---|---|---|---|
| **I – Olfactory** | Olfactory epithelium | Olfactory lobe. | Sensory |
| **II – Optic** | Retina of eye | Mid brain | Sensory |
| **III– Oculomotor** | Crura cerebri of mid brain | Anterior, superior and inferior recti muscles and inferior oblique muscles. of the eyeball. | Motor |
| **IV–Trochlear (Pathetic)** | Midbrain | Superior oblique eye muscles. | Motor |
| **V– Trigemmal** | Medulla ablongata | — | Mixed |
| Ophthalmic | -- | -- | Sensory |
| Maxillary | -- | | Sensory |
| Mandibular | -- | Lower jaw. | Motor |
| **VI– Abducens** | Pons | External rectus muscle of eyeball. | Motor |
| **VII- Facial** | Pons | | |
| Palatine | -- | Palate. | Sensory |
| Chorda tympani | -- | Tongue, salivary glands, taste buds. | Sensory |
| Hyomandibular | -- | Lower jaw, neck, pinna. | Mixed |
| **VIII Auditory** | Medulla | - | -- |
| Vestibular | -- | Utriculus and sacculus. | Sensory |
| Cochlear | -- | Cochlea. | Sensory |
| **IX-Glossopharyngeal** | Medulla | | -- |
| Lingual | -- | Tongue, pharynx, salivary glands. | Mixed |
| Pharyngeal | -- | Pharynx, salivary glands. | Mixed |
| **X- Vagus** | Medulla | - | -- |
| Superior laryngeal | -- | Muscles of larynx. | Motor |
| Recurrent Laryngeal | -- | Muscles of larynx. | Motor |

| | | | |
|---|---|---|---|
| Cardiac depressor | -- | Heart | Motor |
| Pneumogastric | -- | Lungs, oesophagus, stomach. | Mixed |
| **XI -Spinal accesory** | Medulla | Pharynx, larynx, neck, shoulder. | Motor |
| **XII- Hypoglossal** | Medulla | Tongue and hyoid apparatus. | Motor |

*Spinal nerves*

- The number of spinal nerves are as many as the number, of vertebrae. However, in rabbit there are only 37 pairs of spinal nerves because the spinal cord does not extend into the tail.
- Spinal nerves arise from the horns of grey matter by two roots, a dorsal root, which is sensory and the ventral root that is purely motor.
- Thus the spinal nerve is mixed nerve. The spinal nerves leave the vertebral column through intervertebral foramina.
- Each spinal nerve then divides into three branches or rami, **dorsal, ventral and visceral.** The **dorsal ramus** goes to the skin and muscles of the back.
- The **ventral ramus** innervates the latero ventral parts of the body. While the visceral branch or **ramus communicans** joins the sympathetic system supplying the visceral organs.
- The 37 pairs of spinal nerves are divisible **into** five groups, based on the regions of backbone.
    1. Cervical (Neck) - 8 Pairs
    2. Thoracic - 12 Pairs
    3. Lumbar - 7 Pairs
    4. Sacral - 4 Pairs
    5. Caudal or Coccygeal - 6 Pairs
- Cervical spinal nerves go to the skin and muscles of the neck region.
- Ventral branch of III cervical spinal nerve gives of auricular nerve that goes to the pinna.
- The ventral branches of IV, V, VI cervical nerves in the neck form **cervical plexus.** The V, VI**,** VII, VIII cervical nerves and the 1st thoracic nerve form the **brachial plexus** and innervate the muscles of forelimbs through radial, ulnar and mediam nerves.
- IV to VII lumbar and first three sacral nerves form **lumbo-sacral plexus.**
- Nerves from this plexus innervate hindlimbs through **femoral, obturator** and **sciatic** nerves.
- Slender nerves from cervical plexus on either side constitute a phrenic nerve to the muscles of diaphragm.
- Rabbit's spinal cord extends behind only upto the middle of the lumbar region.
- Before emerging out from the intervertebral foramina, the lumbar, sacral and caudal **nerves** extend back along with filum tenninale forming thick bundle of nerves called the **'cauda equina'.**