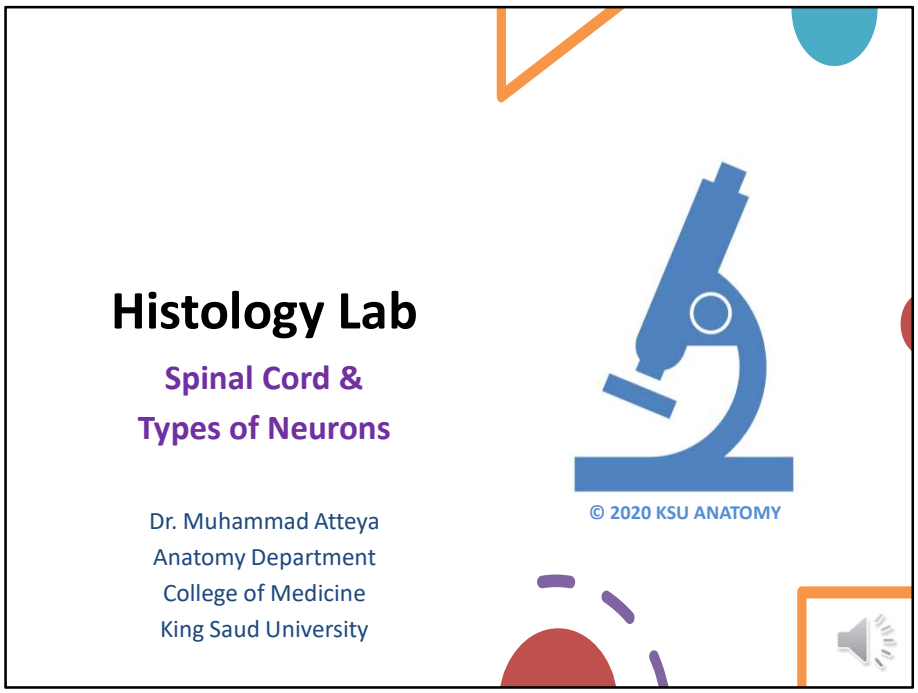
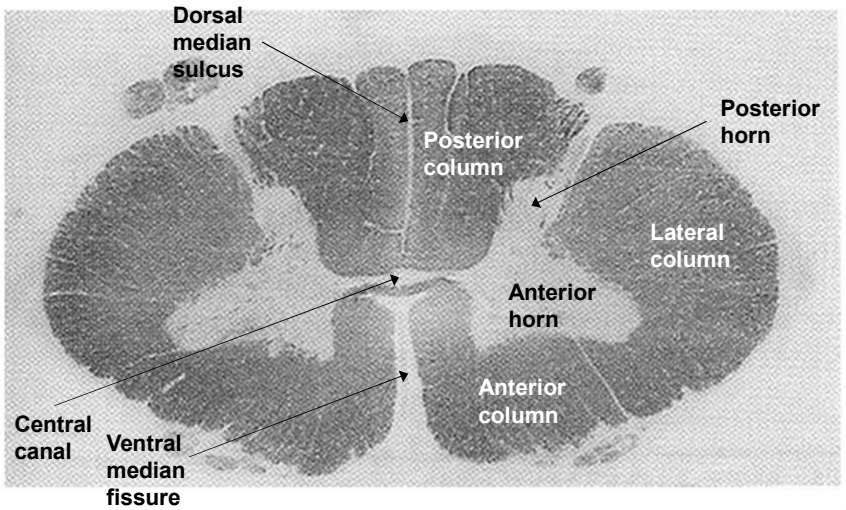


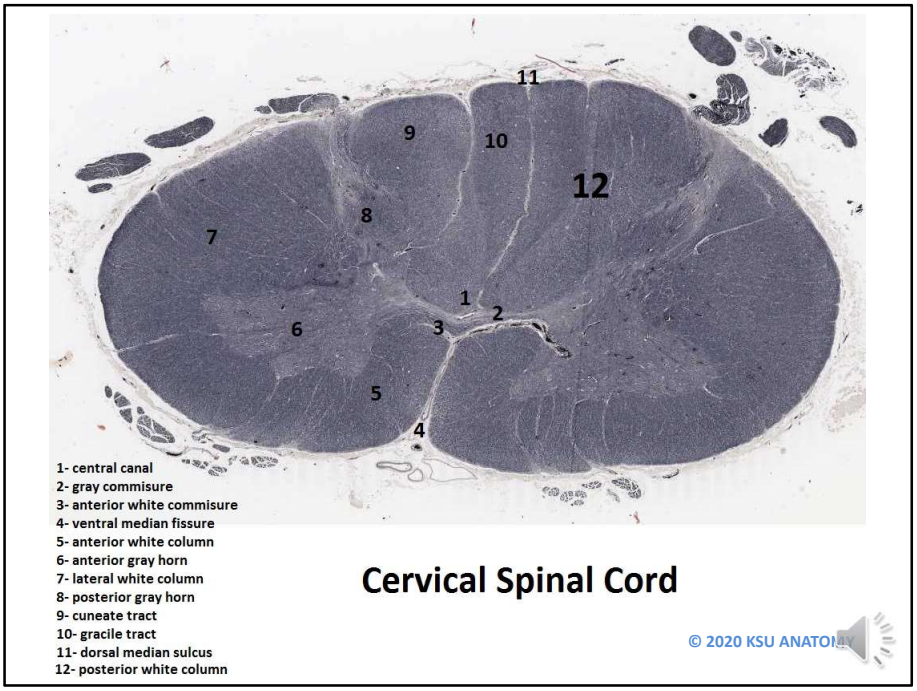

This is the Histology Practical Lab of Spinal Cord & Types of Neurons.






Cervical Spinal Cord

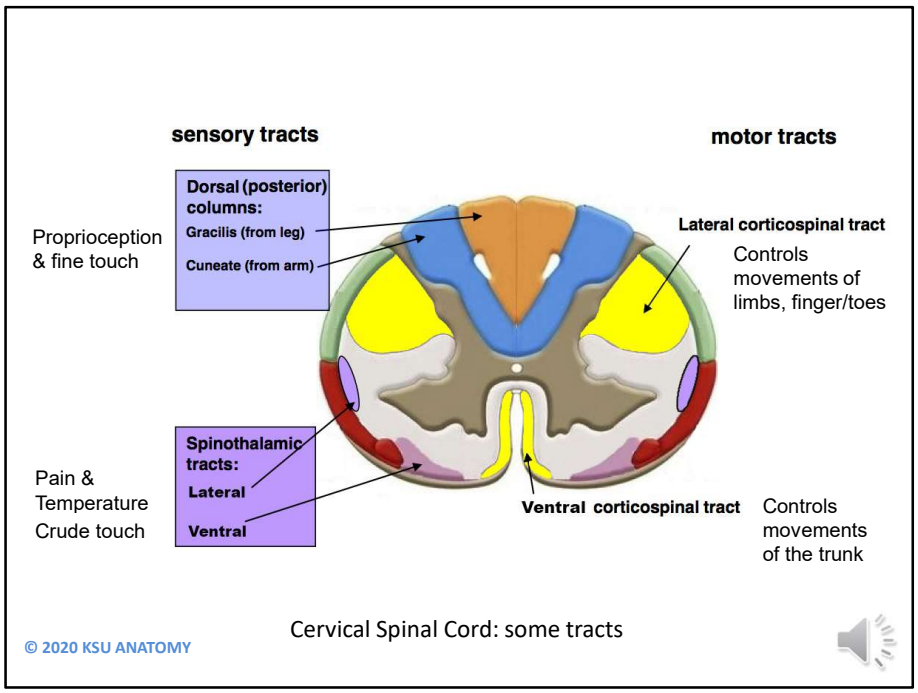
Firstly, the spinal cord sections you are going to see are stained with a special type of hematoxylin that stains myelin black. So the white matter which contains myelinated nerve fibers will stain darker than the gray matter which contains unmyelinated nerve fibers.
Let's take a look on the general anatomy of a section in the spinal cord. The spinal cord is made of gray and white matter just like other parts of the CNS. It shows four surfaces: anterior (ventral), posterior (dorsal), and two lateral. In the midline, there is a central canal, a ventral median fissure and a dorsal median sulcus.
The gray matter is the butterfly-shaped central part of the spinal cord, is made of nerve cell bodies, and shows anterior and posterior horns. Additional lateral horns are seen only in the thoracic level. White matter surrounds the gray matter and is made of axons. It shows anterior, lateral, and posterior columns.




This is a transverse section in the cervical region of the spinal cord.

<u>Identifying features</u>:

1. The section is *oval*.
2. The *central canal is anterior* in position.
3. There are *4 horns* of gray matter:
    a) Two *thin & diverging posterior* horns.
    b) Two *thick anterior* horns.
4. Two important tracts occupy the posterior column of the white matter. These are the gracile and the cuneate tracts.



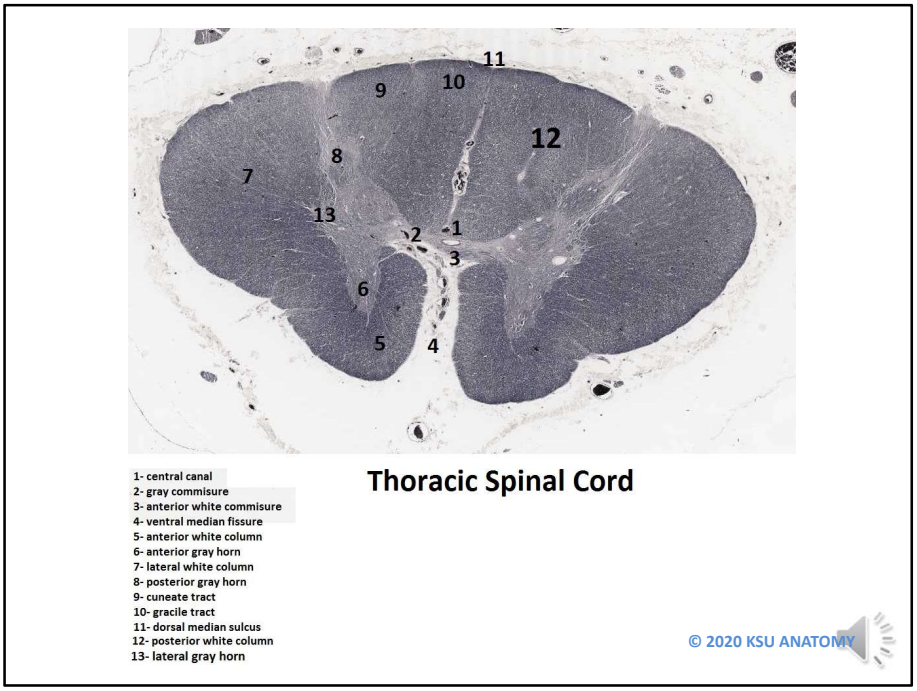

These are some important tracts in the cervical spinal cord. You may be asked to identify the level of this section. You may also be asked to identify a tract or mention some motor (descending) or sensory (ascending) tracts at this level.

**Examples of motor (descending) tracts:**

- Lateral corticospinal: controls movements of the distal region of the body (limbs, fingers/toes).
- Ventral corticospinal: controls movements of the axial region of the body (trunk).

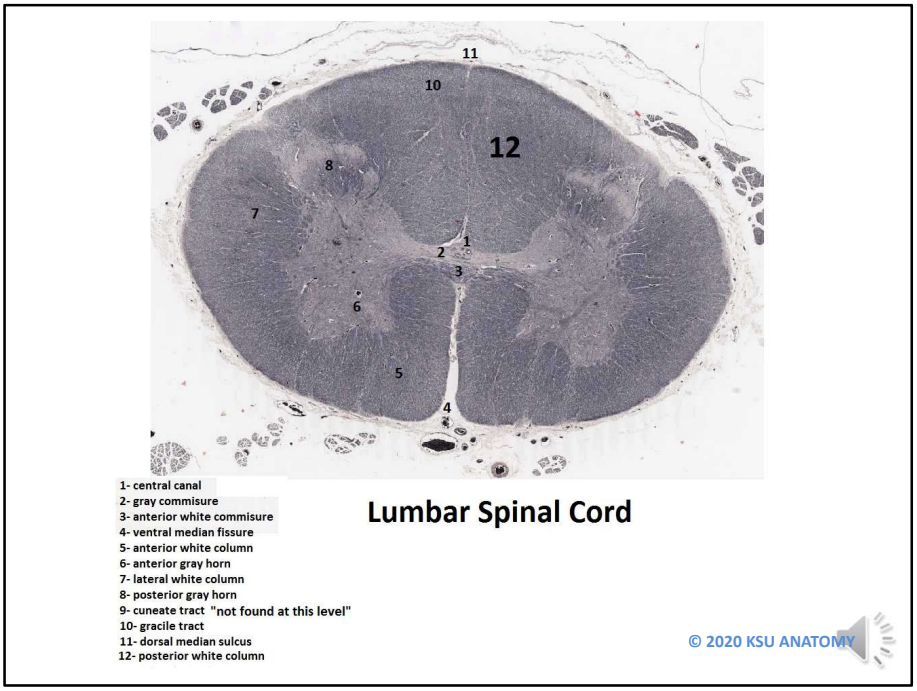
**Examples of sensory (ascending) tracts:**

- Gracile: proprioception and fine touch from lower half of the body.
- Cuneate: proprioception and fine touch from upper half of the body.
- Lateral spinothalamic: pain and temperature.
- Ventral spinothalamic: crude touch.




This is a transverse section in the thoracic region of the spinal cord.
Identifying features:

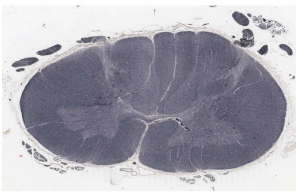
1. The section is *less oval* than the cervical region.
2. The *central canal is more posterior* in position than in the cervical region.
3. There are *6 horns* of gray matter:
    a) Two *thin & diverging posterior* horns.
    b) Two *small lateral* horns.
    c) Two *thin anterior* horns.
4. Two important tracts occupy the posterior column of the white matter. These are the gracile and the cuneate tracts. If the section is in the lower thoracic region, the cuneate tract will be absent.



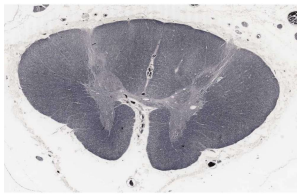

This is a transverse section in the lumbar region of the spinal cord.

<u>Identifying features</u>:

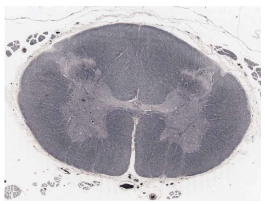
1. The section is *relatively round*.
2. The *central canal is central* in position.
3. There are *4 horns* of gray matter:
    a) Two *thick & almost parallel posterior* horns.
    b) Two *thick anterior* horns.
4. The cuneate tract is absent. Only the gracile tract exists in the posterior column of the white matter.



Cervical Spinal Cord



Thoracic Spinal Cord

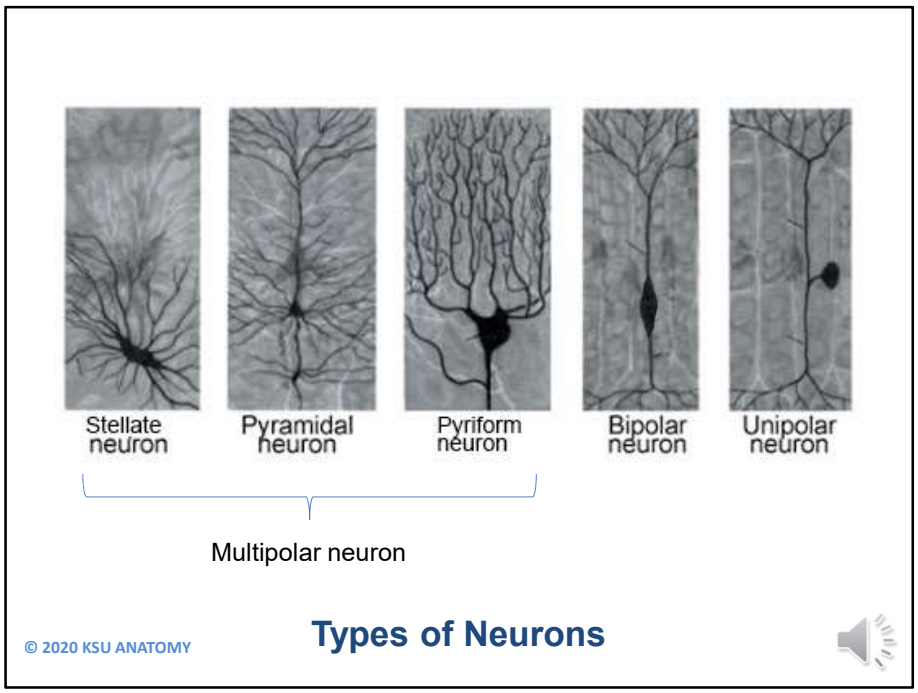


Lumbar Spinal Cord

| | Cervical | Thoracic | Lumbar |
|---|---|---|---|
| **Outline** | oval | less oval than cervical | relatively round |
| **Central canal** | anterior | more posterior | central |
| **Horns** | 4 | 6 | 4 |
| *2 Posterior horns* | thin & diverging | thin & diverging | thick & almost parallel |
| *2 Lateral horns* | no | yes, small | no |
| *2 Anterior horns* | thick | thin | thick |
| **White matter amount** | greater than any other level | great | less than cervical |
| **Overall size** | larger than thoracic | smaller than cervical | relatively large |



The easiest and most consistent way to differentiate between the 3 levels is to look first at the posterior horns. If they are thick and almost parallel, then it's lumbar. If the posterior horns are thin and diverging, it could be either cervical or thoracic. Look at the anterior horns. If they are thin, it's thoracic. If they are thick, it's cervical.

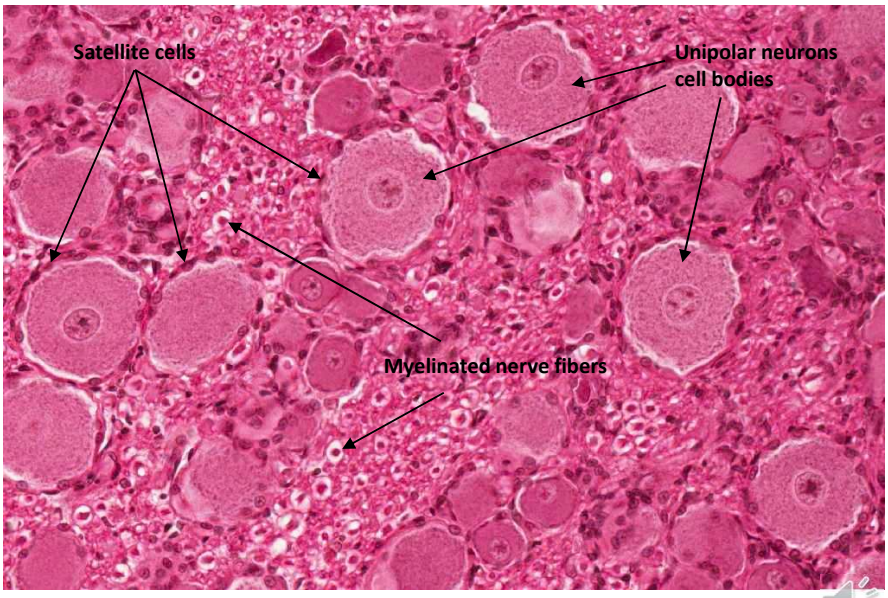



Neurons are classified according to the number of processes into:

1. Unipolar neurons: Cell body is rounded and has one process only, which divides immediately to two branches; one wil be the dendrite and the other will be the axon.
2. Bipolar neurons: Cell body is fusiform and has two processes, one from each pole of the cell body; one is the dendrite and the other is the axon.
3. Multipolar neurons: have one axon and multiple dendrites. They are further classified according to shape of the cell body into:
    a) Stellate neurons: polygonal or star-shaped.
    b) Pyramidal neurons: pyramidal or triangular in shape.
    c) Pyriform neurons: pear- or flask-shaped.

You need to focus on:

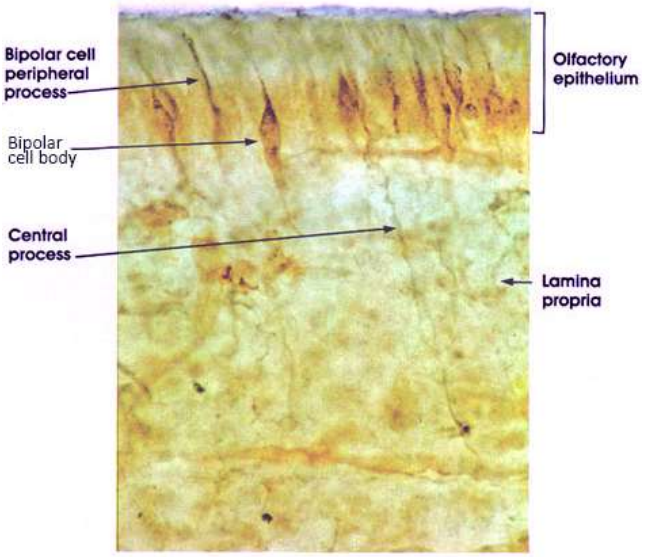
1. Identifying the type of neuron.
2. Knowing where it can be found.




These are unipolar neurons in a spinal (dorsal root) ganglion.
The nerve cell bodies are rounded and variable in size; some are large, others are small. Each nerve cell body is surrounded by a capsule of satellite cells. Nuclei are vesicular with prominent nucleoli. No processes can be seen emerging from the cell bodies. We need to be extremely lucky to see the single process as it passes out of the capsule of satellite cells. A ganglion is a collection of nere cells and nerve fibers. That's why we see also in the picture bundles of nerve fibers, which, here in a spinal ganglion, are myelinated. The white halos around the axons represent dissolved myelin.

**Sites:**
- Spinal gnalgia.
- Mesencephalic nucleus of trigeminal nerve.

**Identifying features** of unipolar neurons include:
- Rounded.
- Variable in size.
- Capsules of satellite cells around them.
- Nuclei vesicular.



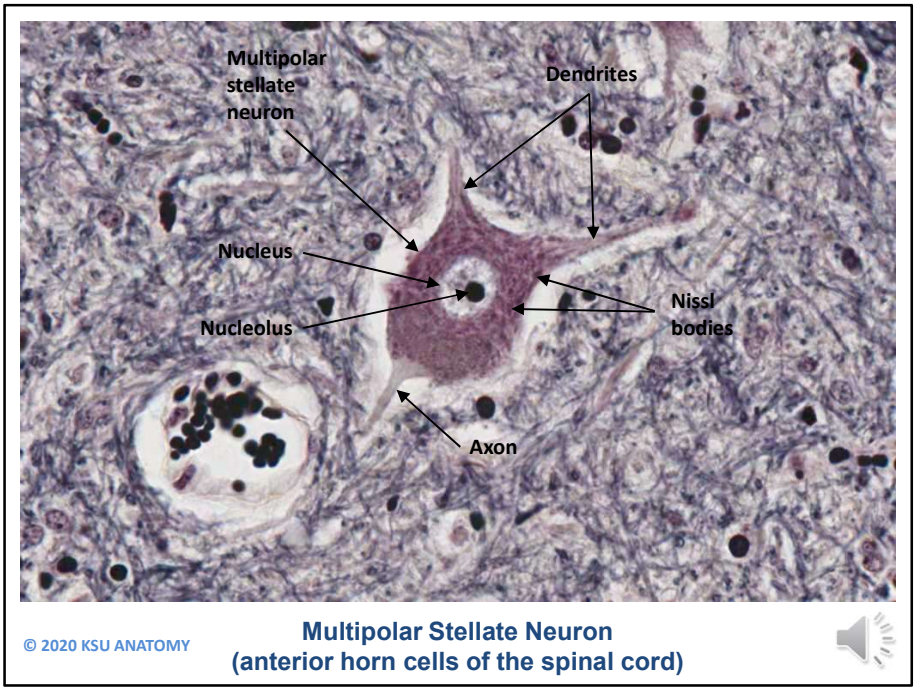

**Bipolar neurons**
**(olfactory cells in olfactory epithelium)**



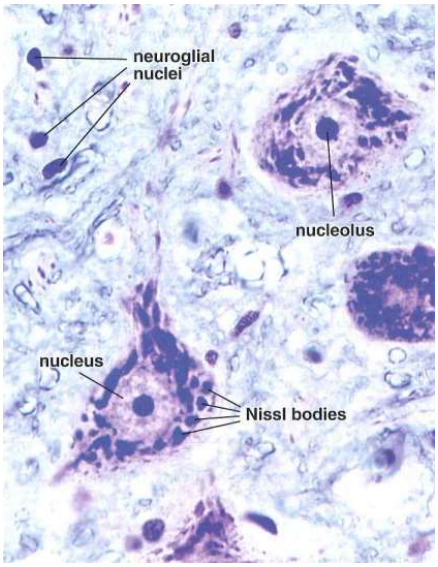
These are bipolar neurons in ollfactory epithelium. In this site they are also called olfactory cells.
The nerve cell bodies are fusiform, and each have two processes; one from either pole of the cell body. The peripheral process is the dendrite and the other is the axon (called central because it's going to the central nervous system).

**Sites:**
- Olfactory epithelium.
- Retina.
- Inner ear.

**Identifying features** of bipolar neurons include:
- Fusiform.
- Two processes; one from either pole of the cell body.




This is a multipolar stellate neuron in the anterior horn of the spinal cord (called anterior horn cell).
The nerve cell body is polygonal or star-shaped. It has one axon and multiple dendrites.
The typical features of nerve cell bodies are visible in this image including large, spherical, pale-stained vesicular nucleus with a prominent nucleolus and abundant Nissl bodies in the cytoplasm.




From Michael H. Ross, Wojciech Pawlina, Histology : a text and atlas—Seventh edition, 2016.



**Multipolar Stellate Neurons**
**(anterior horn cells of the spinal cord)**

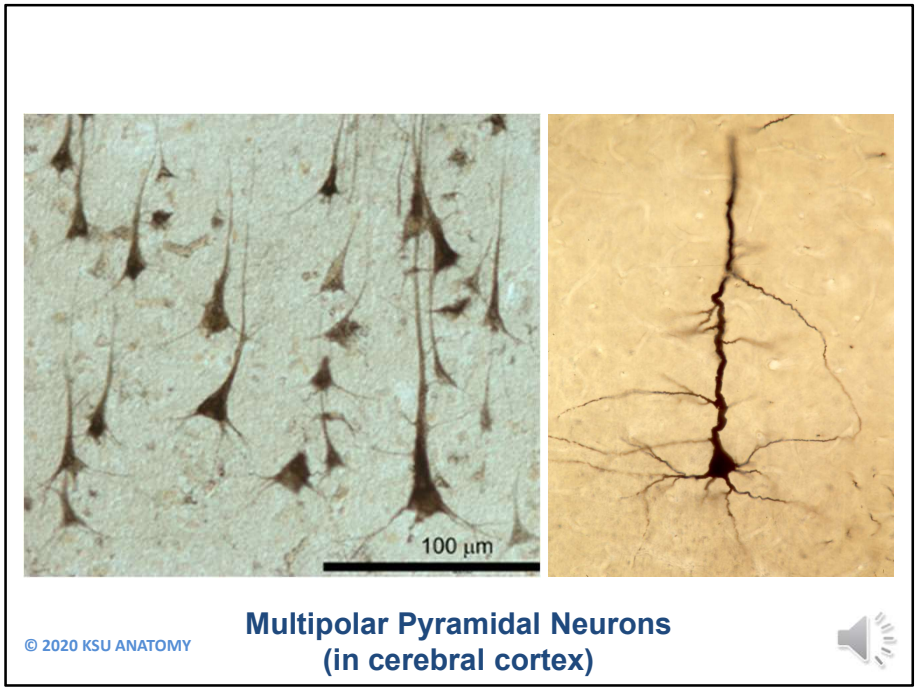
Another picture for multipolar stellate neurons in the anterior horn of the spinal cord (called anterior horn cell).
The section was stained by toluidine blue to show clearly the abundant Nissl bodies in the cytoplasm.
The nerve cell body is polygonal or star-shaped. It has one axon and multiple dendrites.
The typical features of nerve cell bodies are visible in this image including large, spherical, pale-stained vesicular nucleus with a prominent nucleolus and abundant Nissl bodies in the cytoplasm.

**Sites:**

- The commonest type of neurons.
- Distributed in most areas of CNS, e.g.:
    - Anterior horn cells in the anterior horns of the spinal cord.

**Identifying features** of multipolar stellate neurons include:

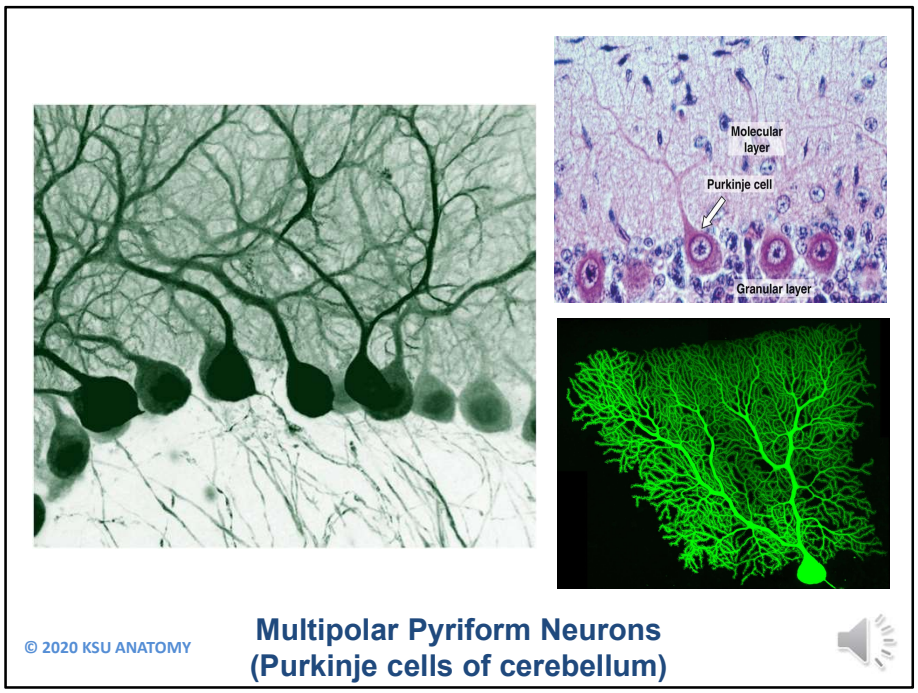
- Polygonal or star-shaped.
- One axon and multiple dendrites.
- Nissl bodies.
- Vesicular nucleus.




These are multipolar pyramidal neurons in the cerebral cortex.
The nerve cell body is pyramidal (triangular) in shape, the apex being directed towards the cortical surface. Each has one axon and multiple dendrites (a large apical dendrite and multiple basal dendrites).

**Sites:**
- Motor area 4 of the cerebral cortex.

**Identifying features** of multipolar pyramidal neurons include:
- Pyramidal or triangular in shape.
- One axon and multiple dendrites.
- Has one large apical and multiple basal dendrites.




These are multipolar pyriform neurons in the cerebellum (cerebellar cortex). They are called Purkinje cells.
The nerve cell body is pyriform in shape or pear- or flask-shaped, They have very large cell bodies, one fine axon extending down, and an extensively branching dendritic system which arborises like a tree.

**Sites:**
- Cerebellar cortex.

Identifying features of multipolar pyriform neurons include:
- Pyriform in shape or pear- or flask-shaped.
- Very large cell body.
- One axon and multiple dendrites.
- Extensively branching dendritic system like a tree.

**Thank You**

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