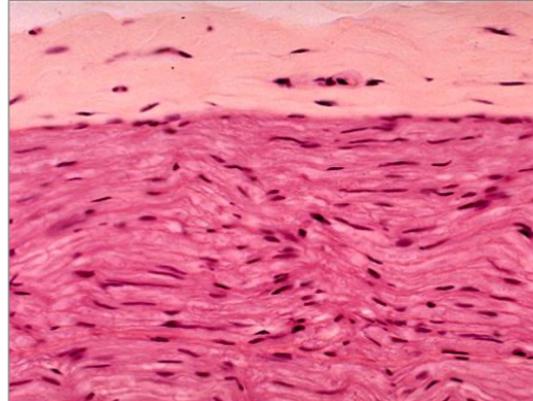


DMF3 - Neuroanatomy and histology

Peripheral nerves (N1: Htx-eosin)

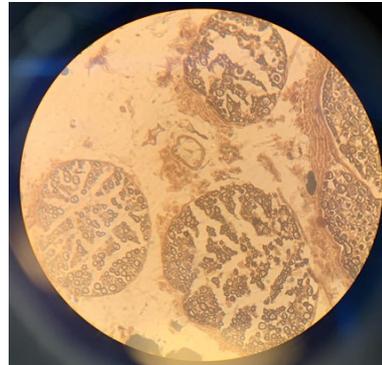
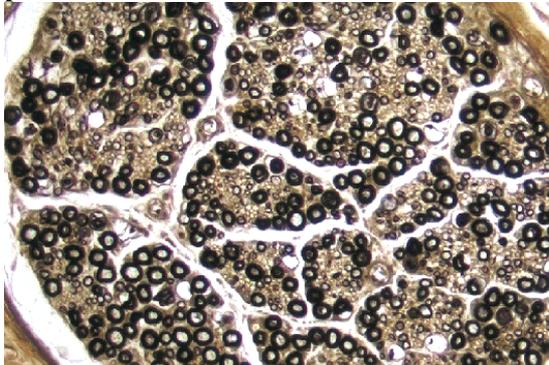
Cross section: Three (2 large and one small) or two (large) cross-sectioned bundles of nerve fibers can be seen, surrounded by a layer of lightly stained connective tissue (**epineurium**). The epineurium may contain blood vessels and fat cells.

The **perineurium** is the layer subjacent to the epineurium, directly surrounding the bundle of nerve fibers. The perineurium is only a few cells thick, but constitutes an important structural and functional boundary between the nervous system and the surroundings. Every single nerve fiber is surrounded by longitudinal fibers of collagen (**endoneurium**).



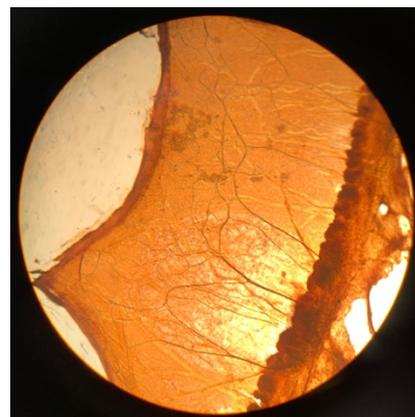
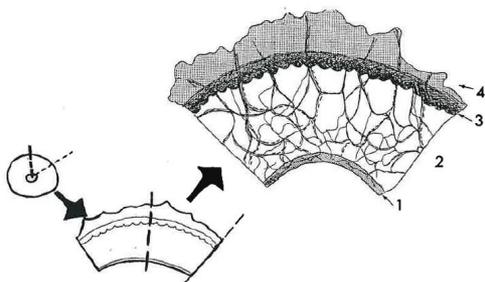
Peripheral nerves (N4:OsO4)

Cross-section: Osmium tetroxide (OsO₄) stains the fat in fat cells and **myelin sheaths black**. The specimen shows several cross-sectioned nerve bundles. The bundles of nerve fibers are surrounded by a dense **epineurium**, stained **lightly brown**, in which **black colored fat cells** are present in the peripheral parts. Each nerve bundle is surrounded by **darker brown** connective tissue, the **perineurium**.



Iris rat - peripheral nerve (N5: Silver staining)

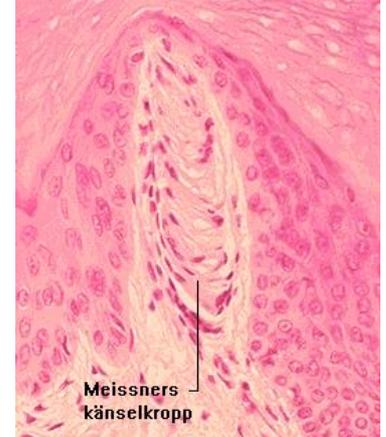
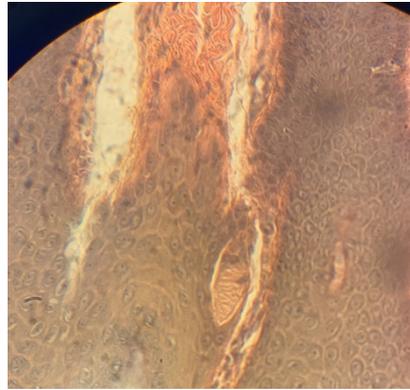
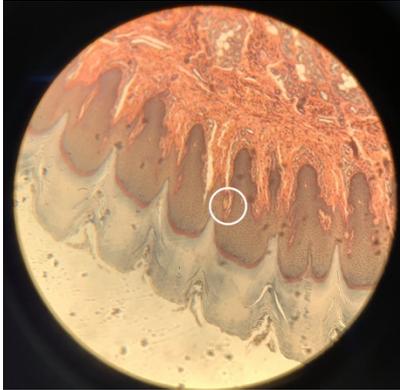
Iris, ciliary body and parts of the **choroid** have been stretched and fixated on top of the slide. This iris was dissected from an albino-rat, therefore it **lacks pigment** and since it is also very thin, this enables microscopy without sectioning. A special silver staining method has been used to stain the sensory innervation of the iris, which is sometimes myelinated and sometimes not. This method of staining makes the **axons and myelin** are **stained black** and gives the **iris tissue** a **brown tint**.



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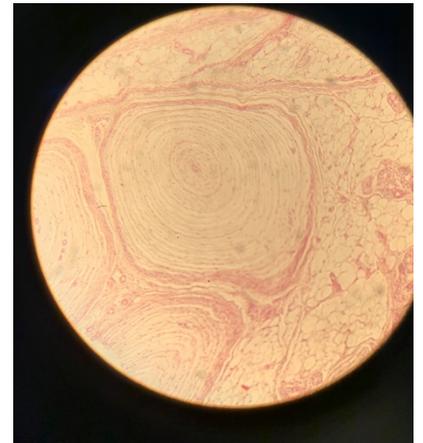
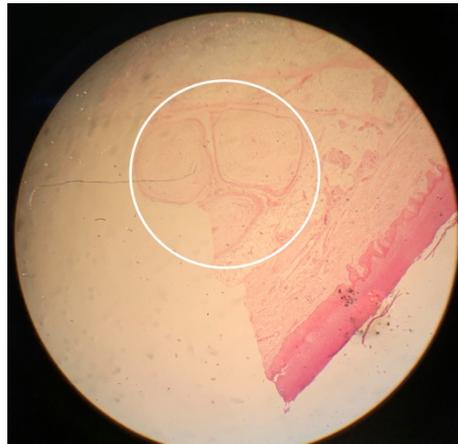
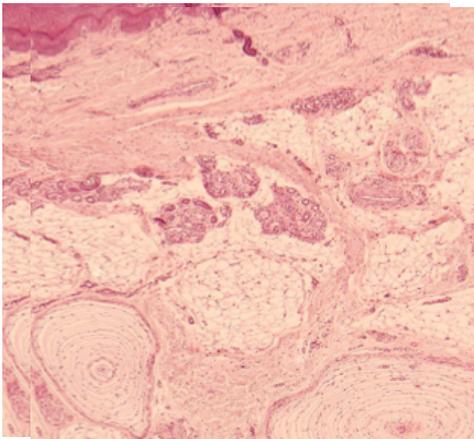
Sensory receptors – Meissner's corpuscle (N6: Htx-eosin)

Section of skin from a monkey with stratified keratinized squamous epithelium (**epidermis**), underlying **connective tissue (dermis)**, sweat glands and subjacent adipose tissue (only on certain preparations). **Meissner's corpuscle** (involved in the perception of touch) are located in the protrusions of connective tissue observed on the border between epidermis and dermis.



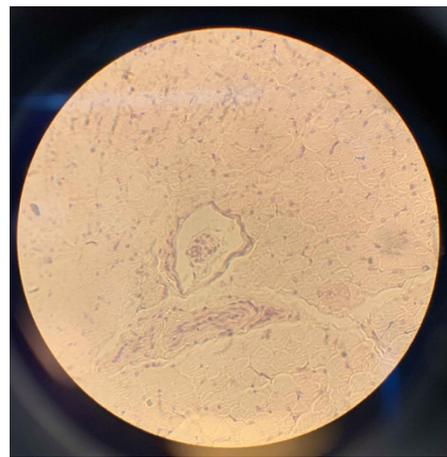
Sensory receptor – Pacinian corpuscle (N7: Htx-eosin)

Section of the skin containing **several sensory receptors**; **Meissner's** corpuscles are present in the junction between epidermis and dermis, and **Pacinian corpuscles** in the **deeper layers** of the skin (hypodermis) surrounded by fatty tissue and connective tissue.



Muscle spindle (N32: Htx-eosin)

This slide represents a **cross section** of a skeletal muscle. **Muscle spindles** are scattered between **bundles of striated muscle cells**. These **sensory receptors** are involved in proprioception and consist of a small number of **smaller intrafusal muscle fibers**, which are **surrounded by a connective tissue capsule**. The nerves of the muscle spindle are not visible with Htx-eosin.



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Neuromuscular junction (N8: Htx-eosin & silver chloride)

Longitudinally sectioned striated muscle fibers are visible in pink and motor neurons innervating the muscle are stained in black. One nerve fiber has several branches, terminating in a neuromuscular junction that appear as a delimited rounded structure.



Ganglia - Dorsal root ganglion (N9: Htx-eosin)

The ganglion is surrounded by a capsule of connective tissue, where occasional fat cells and blood-vessels can be observed. The specimen shows the distinguishing features of a dorsal root ganglia. **Perikarya** (*cell bodies*), with a **large nucleus** and a visible nucleolus, are located in close **contact** with **myelinated nerve fibers**.

The placement of **groups of perikarya** and areas of myelinated fibers gives an overall impression of “good organization”, the cell bodies are arranged in clusters separated by nerve fibers and satellite cells are completely surrounded by the perikarya.

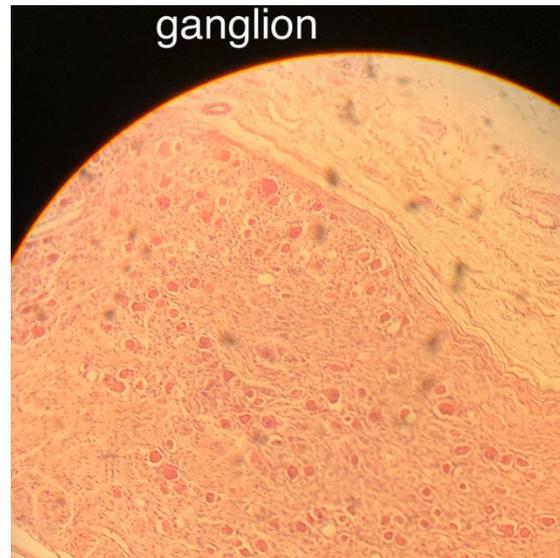
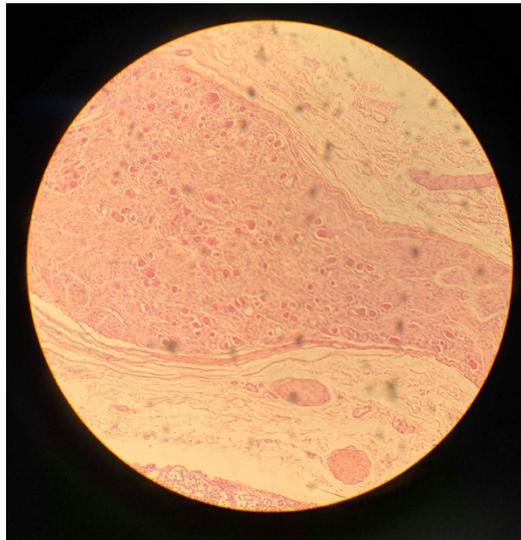


Sympathetic ganglion (N10: Htx-eosin)

This slide contains part of a **sympathetic ganglion** surrounded by a **capsule of connective tissue**. In the surrounding connective tissue we can observe nerves, vessels, and occasional lymph nodes. Distinguishing features of an autonomic ganglion are Cell bodies (**perikarya**) with a nucleus and a **large nucleus** are spread among bundles of **unmyelinated nerve fibers**.

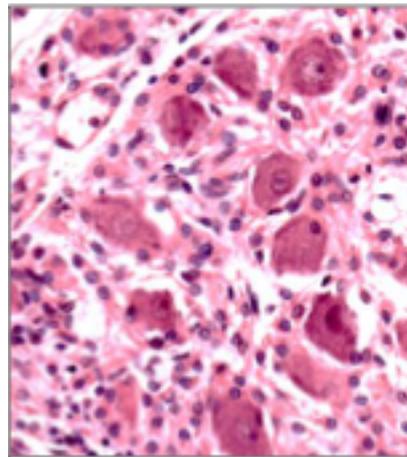
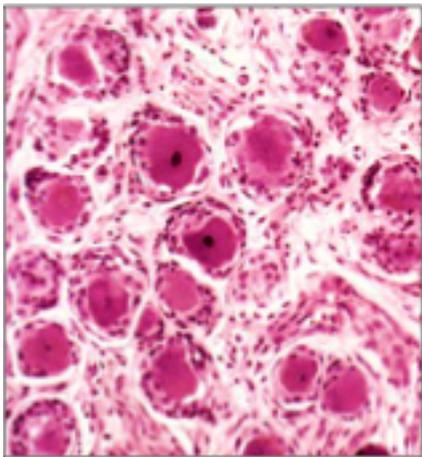
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The spatial location of the cell bodies and their relation to axon bundles gives a more **"irregular impression"** if we compare it with dorsal root ganglia.



Dorsal root ganglion (structured)

Sympathetic ganglion (irregular)



Cortex cerebri (N13 A: Cross-section, Weigert staining)

Note: the slide contains three specimens: **a) cortex cerebri** (closest to the label), **b) cerebellum** (middle), **c) medulla oblongata** (farthest from the label).

Macroscopic analysis: The cortex is divided in **gray matter** (cell bodies from neurons and glia) and **white matter** (composed of axons) Here, a few **rounded gyri (gray matter)** in the cross section are visible to the naked eye, with a small patch of darkly stained white matter in the center.



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Microscopic analysis:

Parts of the **meninges (arachnoid and pia mater)** and a few blood vessels are seen on the surface of the cortex. **Six layers** of the cerebral cortex can be identified. The **first layer** is by definition positioned **closest to the outer surface** of the cortex. It can be difficult to distinguish all six layers from each other.

The neurons are divided into two major groups: **pyramid cells** and **interneurons**. Pyramid cells are large excitatory neurons; they have long axons, projecting to other areas of the cortex and other parts of the brain. The **pyramidal neurons** have a characteristic orientation with **one apical** (pointing outward) and **3-5 basal** (pointing inward) **dendrites**. Their nuclei contain evident nucleoli. Interneurons are smaller neurons forming local circuits.

Lamina 1 – Molecular layer

- few neurons / glia cells

Lamina 2 – Outer granular layer

- small pyramidal neurons
- stellate neurons

Lamina 3 – Outer pyramidal layer

- moderate size pyramidal

Lamina 4 – Inner granular layer

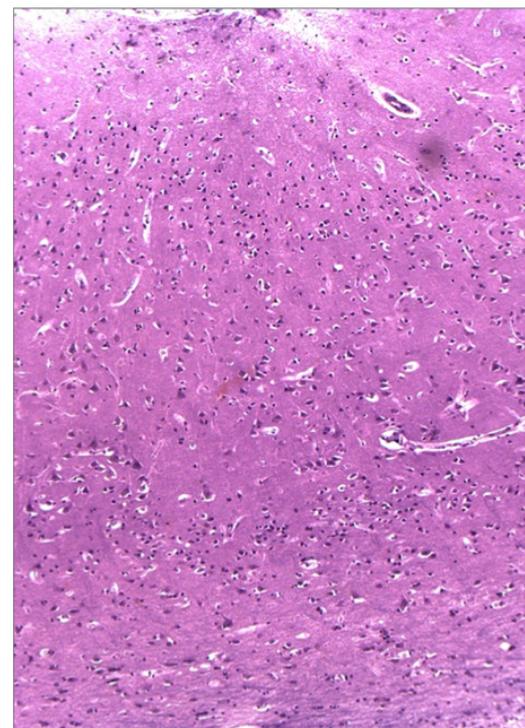
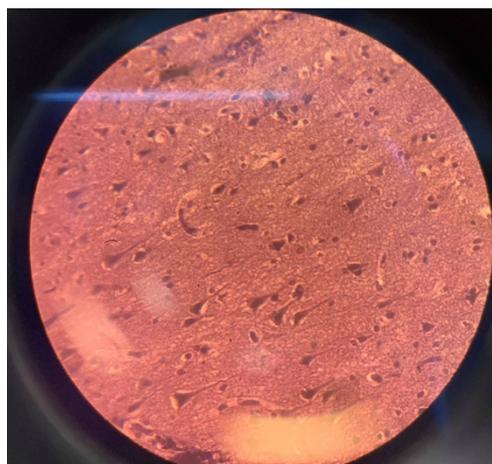
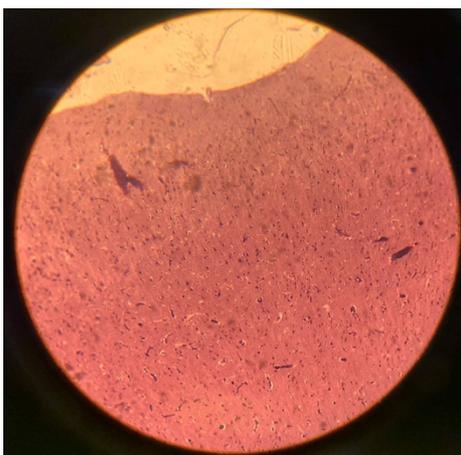
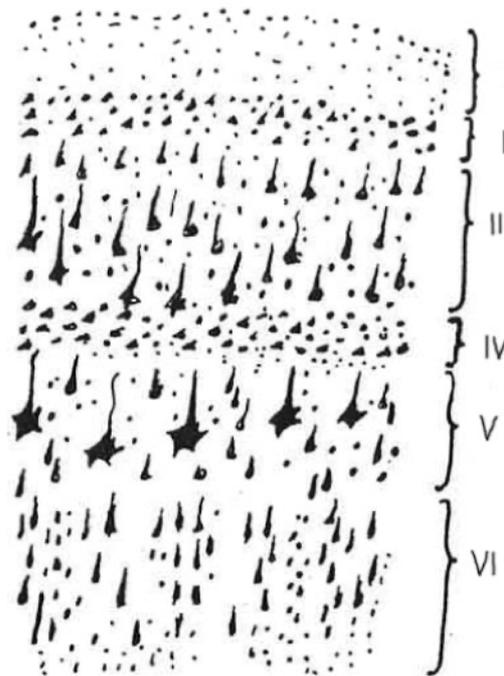
- dense stellate neurons

Lamina 5 – Inner pyramidal layer

- called ganglionic layer
- large pyramidal neurons

Lamina 6 – Multiform cell layer

- mixture of pyramidal and stellate



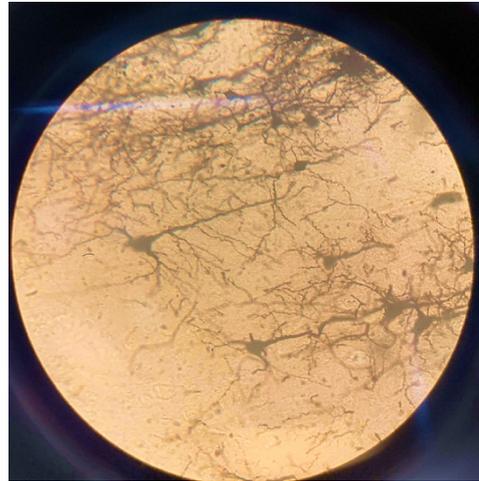
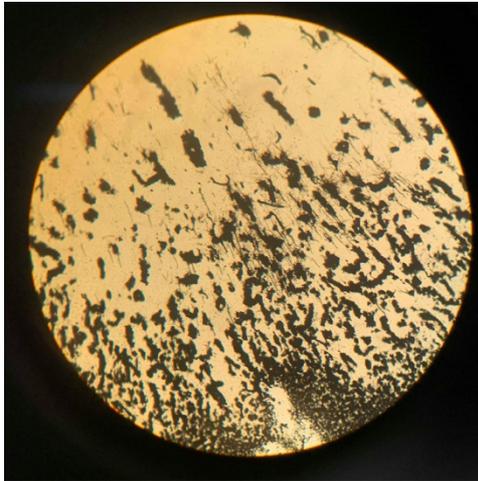
In addition to neuronal cell bodies, the cortex contains numerous blood capillaries and glial cell bodies.

Everything is embedded in **neuropil**, a complex network of dendritic and axonal arborizations, and of glial cell processes.

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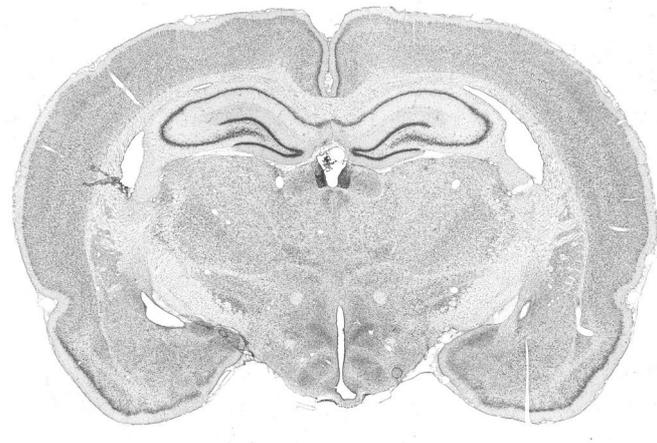
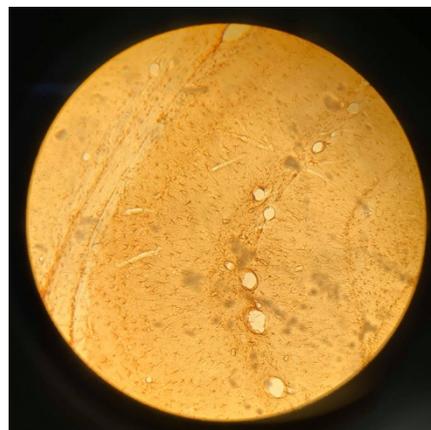
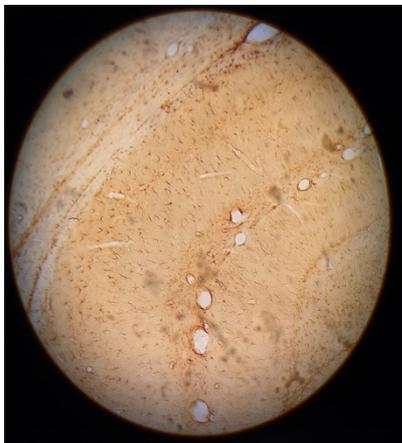
Pyramidal cells (N15: Golgi staining)

The slide contains a **thick section** through the **cerebral cortex**, stained with the classic Golgi method. The **cells that absorb the color** are completely stained, including **dendritic trees** and **axons**. In this preparation, **pyramid cells** and **single interneurons** have been impregnated. The range of dendrites can be observed. Axon bundles in white matter are seen in some preparations.



Astrocytes – Rat (N22: Peroxidase anti-peroxidase (PAP) immunohistochemistry)

In the specimen we observe a **coronal section** of a **rat brain**. **Cortex cerebri** is seen as an **outer surrounding layer**. The **central cavity** corresponds to the **third ventricle**. Please refer to the image below to localize these areas within the section



Astrocytes constitute a group of **glial cells** that can be **easily visualized** using **antibodies** to GFAP (glial fibrillary acidic protein). This preparation is stained with an immunological PAP, which means that **primary antibodies** designed for GFAP have been used to specifically **distinguish** all cells and structures **containing GFAP** protein.