CHAPTER 9: NERVE

There are two classes of cells present within the nervous system - neurons and supporting cells. Neurons are highly specialized cells designed to receive, integrate, and transmit electrochemical impulses. Supporting cells surround the neurons, providing physical support and serving a great variety of other functions (e.g., myelination). In the central nervous system (CNS) the supporting cells are called glia, and in the peripheral nervous system (PNS) they are called satellite cells and Schwann cells (sometimes referred to collectively as the glia of the PNS).

The CNS consists of the brain and spinal cord, which can both be divided into gray matter and white matter. In gray matter you will find the cell bodies of neurons, their dendrites, and the proximal portions of their axons, as well as glial cells. White matter contains only neuronal axons and the glial cells that support them.

The PNS includes peripheral nerves (cranial and spinal), ganglia, and sensory receptors. Neuronal cell bodies, their dendrites, the initial portions of their axons, satellite cells, and Schwann cells are all present in the ganglia, whereas peripheral nerves contain only axons and Schwann cells.

THE NEURON:

Regardless of its location, a typical neuron usually has three parts: a cell body or soma, one axon, and multiple dendrites. The soma includes the nucleus and the cytoplasm that surrounds it, which is called the perikaryon. Neurons vary widely in size and shape, with some shapes being characteristic of their particular location in the nervous system while others are typical of many different locations.

This section of cerebellum (part of the brain) has been treated with silver to fill the neurons and make it easier to visualize their processes. The arrow indicates a Purkinje cell, a large flask-shaped neuron characteristic of cerebellum. Note that a Purkinje cell is a true neuron, while a Purkinje fiber is a modified cardiac myocyte. The soma and the dendrites of the Purkinje cell are well demonstrated here but the axon is not visible. It is a long slender process that would arise from the soma at the pole opposite from the dendrites and extend into the deeper layers of the cerebellum.

This thick section has been impregnated with heavy metals via the Golgi procedure. The cytological detail of the soma is obscured by the large amount of metal within the cell, but the dendrites are well defined. Dendrites tend to be highly branched in order to increase the surface area.
available for receiving incoming signals. All the dendrites and all their branches are collectively referred to as the neuron's dendritic tree because of their resemblance to the branching pattern of a tree.

Frame 15661
Nissl Body
Nissl Stain 40x

Neurons tend to have a large, euchromatic nucleus and a prominent nucleolus, indicating that they use a large proportion of their genome and are active in protein synthesis. Correlated with this intense protein synthesis is the presence of Nissl bodies (Nissl substance) in the perikaryon of some neurons. The arrow indicates one of the many Nissl bodies in this neuron. A Nissl body is a stack of short cisternae of rough endoplasmic reticulum with free polysomes interspersed between the cisternae. Nissl bodies are highly basophilic due to their high ribosomal RNA content, and are best demonstrated with “Nissl stains” such as cresyl violet.

Frame 15724
Axon Hillock
Nissl Stain 160x

Neurons generally have a single axon, which carries impulses away from the cell body. Axons tend to be longer than dendrites and branch much less. It can be difficult to distinguish between an axon and a dendrite unless you can see the area known as the axon hillock. This is the region of the perikaryon from which the axon arises. It lacks Nissl bodies and hence tends to stain paler (arrow). In contrast, Nissl bodies often extend into the proximal part of a dendrite (see the neuron just above the labeled one). Note also the variation in neuronal size. The labeled cell is so large that the nucleus is out of the plane of section.

Most neurons fall into one of three general structural patterns, multipolar, bipolar, or pseudounipolar. Multipolar neurons have a single axon and multiple dendrites, and are very common (e.g., the somatic motor neurons that innervate skeletal muscle, or the sympathetic and parasympathetic neurons of the autonomic nervous system). Bipolar neurons have one axon and one dendrite and are much less common. They are found in the retina, the olfactory epithelium, and the ganglia of the inner ear (associated with cranial nerve VIII). Pseudounipolar neurons have one process arising from their cell bodies which then splits into a central process (an axon) and a peripheral process (functionally a dendrite but with a structure that more closely resembles an axon). Sensory neurons in the dorsal root ganglia and the sensory ganglia of cranial nerves are pseudounipolar.
This neuron (arrow) must be multipolar because we can see 3 processes extending from the soma, and it is very possible that more are present but are out of the plane of this section. In sectioned neurons where only one or two processes are visible, it is not possible from that information alone to determine if the cell is multipolar.

CNS SUPPORT CELLS (GLIA):

The morphology of CNS glia will be studied more extensively in the Neuroscience course. For now it is sufficient if you are able to distinguish glia from neurons, know the names of the various types of CNS glia, and know some of the functions they perform.

CNS glia outnumber the neurons roughly 10:1. They are smaller than neurons, and often have little or no cytoplasm visible by light microscopy. Like neurons they have abundant and extensive processes but they are not specialized to conduct nerve impulses as neurons do. The major types of CNS glia are astrocytes, oligodendrocytes, microglia, and ependymal cells. They are morphologically fairly similar to one another by light microscopy unless special stains are used.

Astrocytes are the largest glial cell. Some of their branching cytoplasmic processes end in expanded pedicles (vascular endfeet), which surround capillaries as part of the blood-brain barrier. Other processes (subpial feet) form a layer (the glia limitans) just beneath the pia mater at the surface of the brain and spinal cord. Tumors arising from astrocytes account for the great majority of primary brain tumors in adults.

Oligodendrocytes are the most numerous of the glial cells. They have small spherical nuclei. They are responsible for forming the myelin sheaths that surround some CNS axons. In the PNS myelination is done by Schwann cells.

Microglia are the smallest and rarest of the glia. These cells have very small heterochromatic, elongated nuclei (often bean shaped). Microglia are phagocytic and are derived from bone marrow precursors. They increase in number at sites where debris accumulates (i.e., sites of disease or trauma).

Ependymal cells line the fluid-filled spaces within the brain (ventricles and aqueducts) and spinal cord (the central canal). They resemble simple columnar epithelial cells, but some have basal processes that extend deep into the surrounding gray matter. Specialized ependymal cells in the ventricles of the brain form part of the choroid plexus, which produces cerebrospinal fluid (CSF). CSF
circulates through the ventricles, aqueducts, and central canal, and also passes via specialized apertures into the subarachnoid space that surrounds the outer surface of the CNS. Ependymal cells also have apical microvilli that contribute to the reabsorption of CSF as part of its normal turnover.

SPINAL CORD:

Frame 15550
Spinal Cord
Silver Stain 8x

The spinal cord consists of an outer layer of white matter, surrounding a butterfly-shaped area of gray matter (staining an orange color here). It is the myelin of myelinated axons that gives white matter its lighter color in the fresh state. Neuronal cell bodies (stained dark brown here) are found only in the gray matter. Glia (not stained by this technique) are present in both gray and white matter. The gray matter surrounds the central canal (arrow), which is lined by ependymal cells. It contains CSF and is continuous with the ventricles of the brain.

Frame 15556
Spinal Cord
Ventral Horn
Silver Stain 8x

The gray matter can be divided into a dorsal horn (also called the posterior horn) that receives sensory (afferent) input from the peripheral nerves, and a ventral horn (arrow) (also called the anterior horn) that contains the cell bodies of many motor (efferent) neurons.

Frame 15598
Spinal Cord
Dorsal Horn
Nissl Stain 8x

The arrow indicates the dorsal horn in this Nissl-stained cross section of spinal cord. Notice that neuronal cell bodies are visible with this technique (the dark basophilic dots), and that the neurons in the dorsal horn tend to be smaller on average than those in the ventral horn.

Frame 15679
Spinal Cord
Glial Cell
H&E 160x

This image contains one neuronal cell body at the center of the field. The smaller nuclei, whose scant cytoplasm is difficult if not impossible to see, belong to glial cells. The meshwork of eosinophilic material between the cells consists of the neuronal axons and dendrites plus the cytoplasmic processes of the glia. It is called the neuropil.

PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system (PNS) encompasses all neural tissue other than the brain and spinal cord. It thus includes peripheral nerves (spinal and cranial), ganglia (sensory and autonomic), and sensory receptors.
SENSORY GANGLIA

Sensory ganglia include those on spinal nerves (the dorsal root ganglia or spinal ganglia) and those present on some cranial nerves. Both have a similar morphology.

This image shows a dorsal root ganglion (DRG). It contains the cell bodies of pseudounipolar sensory neurons (arrow). A single process arises from their soma and splits into a peripheral process (which picks up sensory information from the rest of the body and carries it toward the soma) and a central process (which carries the stimulus to the CNS). These cells are called pseudounipolar because during their development they start out with two cellular processes that gradually grow together to form only one. They are also sometimes referred to as unipolar.

In favorable sections such as this and the preceding image, DRGs have a layered appearance in which groups of neurons alternate with bundles of nerve fibers (arrow) that represent the central and peripheral processes these cells.

DRG neurons show a wide range of sizes, with some being extremely large (arrow). They have a very euchromatic nucleus, which tends to be centrally located within the soma, and a prominent nucleolus. Note the neuron to the left of the labeled cell, which is so large that its nucleus is entirely out of the plane of section. Also find the small, dark nuclei that belong to the support cells of the PNS.
Lipofuscin is undigested material, thought to be derived primarily from lipids, that is contained within residual bodies (old lysosomes). It is a naturally pigmented material often described as “golden brown” in color, which would be visible even in unstained sections. Lipofuscin tends to accumulate with age and is sometimes referred to as “age pigment”. It can accumulate in other cell types in addition to neurons, especially in cells that are highly active metabolically (e.g., hepatocytes) or that rarely if ever divide (e.g., cardiac muscle).

Satellite cells and Schwann cells are the two types of support cells found in the PNS. Satellite cells (arrow) are present in sensory and autonomic ganglia. They form a single layer of cells immediately surrounding the neuronal cell body. Their cytoplasm is very thin, and can be difficult to see unless shrinkage of the neuron during tissue preparation has created an artifactual space between the neuronal soma and the layer of satellite cells (as in this image). The other small nuclei in a ganglion that are not in direct contact with a neuronal soma belong mainly to Schwann cells and are associated with the neuronal processes.

AUTONOMIC GANGLIA

Autonomic ganglia include the following: ganglia of the sympathetic nervous system (i.e., paravertebral or sympathetic chain ganglia, and prevertebral ganglia such as the celiac, superior mesenteric, and inferior mesenteric ganglia), the parasympathetic system (i.e., terminal ganglia in or near the organ they innervate), and the enteric ganglia of the GI tract. Autonomic ganglia contain motor neurons since the autonomic nervous system is by definition a motor system. Whereas synapses are not a characteristic feature of the sensory ganglia described in the previous section, an autonomic ganglion is a site where preganglionic neurons synapse on postganglionic. The postganglionic neurons innervate targets such as smooth muscle, cardiac muscle, and glands.

Autonomic ganglia vary greatly in size. Some sympathetic ganglia can be very large (much larger than spinal ganglia), while enteric ganglia and most parasympathetic ganglia are quite small. Enteric ganglia are organized into two plexuses that lie in different layers of the wall of the gut. The myenteric plexus (Auerbach’s plexus) lies between the two layers of smooth muscle that make up the muscularis externa. The submucosal plexus (Meissner’s plexus) is named for its location in the connective tissue layer called the submucosa.
This is one of the larger autonomic ganglia, possibly one of the paravertebral ganglia (sympathetic chain ganglia) that form a chain along either side of the vertebral bodies of the spinal column.

Autonomic neurons (arrow) can be distinguished from sensory neurons because the autonomic neurons are smaller on average and, as is the case with several of the cells in this frame, their nuclei often tend to be eccentric (i.e., located peripherally rather than centrally within the soma).

Because autonomic neurons are multipolar, the layer of satellite cells that surrounds them is interrupted in many places by the multiple processes extending from the soma. Therefore you will see relatively fewer satellite cell nuclei (arrow) around an autonomic ganglion cell than around the pseudounipolar neurons in a sensory ganglion.

The myenteric and submucosal plexuses can be distinguished from one another by their location in the gut wall. Here the neural tissue lies between two layers of smooth muscle. It is therefore the myenteric (Auerbach’s) plexus. The arrow indicates a myenteric ganglion since that area contains several neuronal cell bodies. The light-staining tissue immediately to the left of the ganglion lacks neuronal somas, and represents a bundle of axons. The nuclei within the axon bundle belong mainly to Schwann cells. Axon bundles connect all the myenteric ganglia into a single network and also connect with the ganglia of the submucosal plexus.

The submucosal plexus is an interconnected network of small ganglia that lie in the submucosal connective tissue layer of the GI tract. The arrow points to the soma of a ganglion cell whose nucleus is not visible. Euchromatic nuclei of three other neurons are seen at the lower edge of the ganglion. At the bottom of the field are the two smooth muscle layers of the muscularis externa. Myenteric ganglia (not present here) would be located between these two muscle layers. The enteric nervous system can function autonomously, but the ganglia do receive input from the sympathetic and parasympathetic systems that can modify their intrinsic activity.
A peripheral nerve is a bundle of nerve axons and supporting cells (Schwann cells) held together by connective tissue. The arrow indicates a longitudinally sectioned nerve, while in the lower left corner is a nerve that has been more nearly cross-sectioned. The longitudinal section illustrates the wavy quality that is often observed in peripheral nerve.

The great majority of nuclei in a peripheral nerve belong to Schwann cells (arrow), which are associated with unmyelinated as well as myelinated axons. A small number of the nuclei belong to fibroblasts. Note that none of the nuclei belong to neurons, since the presence of neuronal cell bodies would by definition mean that the structure was a ganglion and not a peripheral nerve.

This image shows cross sections through many nerve fibers, most of which are myelinated. The central density (arrow) within a myelinated fiber is the axon. It is not a nucleus. The nuclei of Schwann cells lie at the outer surface of the myelin sheath, and fibroblasts lie between nerve fibers.

This is a cross section through a nerve that contains a mixture of myelinated and unmyelinated nerve fibers. The myelinated fibers are larger in diameter (arrow) and have a central axon surrounded by a light-staining area representing the extracted myelin sheath. Schwann cells form the myelin sheath by wrapping many times around the axon. The cytoplasm of the Schwann cell is squeezed out from between these layers so that essentially all of it lies either on the inner or outer surface of the myelin sheath. Since the sheath is composed primarily of Schwann cell membrane lipids, it is usually at least partially extracted during tissue preparation resulting in a pale appearance. Also find the unmyelinated axons, which are the smaller circular structures interspersed among the myelinated axons, and the dark nuclei of Schwann cells. Be sure you can distinguish the latter from the axons in the center of the myelin sheaths.
When the lipids of the myelin sheath are well preserved, they stain dark brown or black with osmium stains (arrow).

This image shows peripheral nerve fibers that are more longitudinally oriented. Nodes of Ranvier (arrow) are gaps between segments of the myelin sheath. Since each segment is formed by a different Schwann cell, a node therefore represents the site where the myelin sheaths formed by two adjacent Schwann cells abut one another.

Within each segment of the myelin sheath are pale-staining, arrowhead-shaped structures called clefts of Schmidt-Lanterman (arrow). A cleft is an area where the Schwann cell cytoplasm has not been completely squeezed out as the myelin sheath forms. Each cleft is actually a thin tubule of cytoplasm that spirals around the axon with each turn of the myelin sheath. It thus establishes continuity between the Schwann cell cytoplasm on the outer surface of the myelin sheath (where the nucleus resides) and the inner surface of the sheath. Such a connection is essential for maintaining the viability of the inner layer of cytoplasm.

CONNECTIVE TISSUE COMPONENTS OF A PERIPHERAL NERVE

The connective tissue stroma of a peripheral nerve can be organized into three different components that are analogous to the layers found in skeletal muscle. In nerve they are called the endoneurium, perineurium, and epineurium.

The endoneurium is the delicate loose connective tissue found between nerve fibers within a fascicle. The collagen fibrils are probably made mainly by Schwann cells, although small numbers of fibroblasts are also present. In this trichrome-stained section the endoneurium is barely visible as faint blue wisps (arrow).
The perineurium is a layer of highly specialized squamous cells that encircle a group of nerve fibers to form a fascicle. These cells are connected by tight junctions to form a permeability barrier that helps regulate the ionic environment within the fascicle and thus influences impulse transmission. The cells of the perineurium share some characteristics with smooth muscle myocytes in that they are contractile, and with fibroblasts in that they appear to be able to produce collagen fibrils.

The epineurium is composed of a looser, less specialized connective tissue than the perineurium. In a nerve that contains more than one fascicle, the epineurium not only covers the outermost surface of the nerve (arrow), but also binds the individual fascicles together. The epineurium becomes continuous with the dura mater as the peripheral nerve approaches the CNS.

**COMPARISON BETWEEN PERIPHERAL NERVE AND SMOOTH MUSCLE**

In longitudinal section, a peripheral nerve often appears very wavy. This waviness allows the nerve to stretch quite a bit without being damaged. Note that if the nerve is composed mainly of unmyelinated fibers it will stain darkly with H&E and closely resemble smooth muscle.

Smooth muscle has less tendency toward waviness. The cells are usually arranged in well-defined layers in tubular organs (e.g., in the GI tract) or in interlacing bundles in spherical organs such as the uterus and urinary bladder. There is relatively little connective tissue between layers and around bundles of smooth muscle, in contrast to the prominent perineurium of nerve fascicles.

**ENCAPSULATED SENSORY RECEPTORS**

Pacinian corpuscles, Meissner’s corpuscles and muscle spindles are three relatively common types of encapsulated sensory receptors found in the PNS.
Pacinian corpuscles are very large encapsulated sensory receptors that respond to vibrational stimuli and pressure. In the skin, they are found in the deep regions of the dermis and in the hypodermis, but they can also be found in other locations such as the pancreas, or in association with joints.

When cut in cross section, a Pacinian corpuscle has the appearance of an onion. Concentric layers of flattened cells form an outer capsule, and flattened Schwann cells form an inner capsule around the axon.

Meissner's corpuscles are sensory receptors specialized for fine touch that are limited to the dermal papillae of the skin. They are elongated ovoid structures oriented with their long axis perpendicular to the surface of the skin.

Within the capsule of a Meissner's corpuscle, the nuclei of flattened Schwann cells (arrow) form layers oriented roughly at right angles to the long axis of the corpuscle. One or two axons spiral through the corpuscle but are generally not detectable with routine H&E staining.
MUSCLE SPINDLES

Muscle spindles are specialized stretch receptors found in skeletal muscle. They consist of an outer and an inner capsule that surround modified skeletal muscle cells known as intrafusal fibers. The intrafusal fibers are arranged in parallel with the ordinary skeletal muscle fibers located outside the spindle (extrafusal fibers). Intrafusal fibers are innervated by sensory nerves. Sufficient stretch of the muscle will elicit an impulse in these sensory nerves that will be transmitted to the spinal cord. There the sensory neurons synapse on somatic motor neurons that innervate the extrafusal fibers, causing a reflex contraction of the muscle. The contraction prevents any damage that excessive stretch might have eventually caused. Intrafusal fibers also receive motor innervation, which allows for variation in their state of contraction, thus adjusting the sensitivity of the muscle spindle to stretch.

The muscle spindle (here cut in cross section) has a thicker outer capsule and a more delicate inner capsule (arrow) that surround several intrafusal muscle fibers. Notice that the intrafusal fibers are considerably smaller than the extrafusal fibers. The nerve fascicle in the upper right corner may include the sensory and motor fibers that innervate the muscle spindle.
<table>
<thead>
<tr>
<th>Frame</th>
<th>Type</th>
<th>Magnification</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>26189</td>
<td>H&amp;E</td>
<td>16x</td>
<td>1. Identify this structure.</td>
</tr>
<tr>
<td>13279</td>
<td>H&amp;E</td>
<td>16x</td>
<td>2. Identify the light-staining connective tissue layer indicated by the arrow.</td>
</tr>
<tr>
<td>13064</td>
<td>H&amp;E</td>
<td>160x</td>
<td>3. Identify the predominant tissue seen in this field.</td>
</tr>
<tr>
<td>16577</td>
<td>H&amp;E</td>
<td>40x</td>
<td>4. This cell is most likely to be which of the following: bipolar neuron, multipolar neuron, pseudounipolar neuron?</td>
</tr>
<tr>
<td>13345</td>
<td>H&amp;E</td>
<td>160x</td>
<td>5. Identify the predominant tissue seen in this field.</td>
</tr>
<tr>
<td>16431</td>
<td>Trichrome</td>
<td>16x</td>
<td>6. Identify the dark-staining layer indicated by the arrow.</td>
</tr>
<tr>
<td>16800</td>
<td>H&amp;E</td>
<td>160x</td>
<td>7. Based on its location, the tissue in which the tip of the arrow lies is a/an _________. Be specific.</td>
</tr>
<tr>
<td>14275</td>
<td>H&amp;E</td>
<td>80x</td>
<td>8. Identify this tissue.</td>
</tr>
<tr>
<td>16294</td>
<td>H&amp;E</td>
<td>40x</td>
<td>9. The tissue indicated by the arrow is which of the following: dense regular connective tissue, peripheral nerve, sensory ganglion, smooth muscle?</td>
</tr>
<tr>
<td>14538</td>
<td>H&amp;E</td>
<td>160x</td>
<td>10. Identify the structure indicated by the arrow.</td>
</tr>
<tr>
<td>16068</td>
<td>H&amp;E</td>
<td>160x</td>
<td>11. Identify the cell to which this nucleus belongs.</td>
</tr>
<tr>
<td>17053</td>
<td>H&amp;E</td>
<td>160x</td>
<td>12. Identify this structure.</td>
</tr>
<tr>
<td>16303</td>
<td>H&amp;E</td>
<td>80x</td>
<td>13. Identify the thin dark-staining layer near the tip of the arrow.</td>
</tr>
<tr>
<td>13580</td>
<td>H&amp;E</td>
<td>40x</td>
<td>14. Identify the layer of tissue indicated by the arrow.</td>
</tr>
<tr>
<td>16523</td>
<td>H&amp;E</td>
<td>160x</td>
<td>15. Identify the cell indicated by the arrow.</td>
</tr>
<tr>
<td>13363</td>
<td>H&amp;E</td>
<td>80x</td>
<td>16. Identify the tissue indicated by the arrow.</td>
</tr>
</tbody>
</table>
| 13622 | H&E  | 160x          | 17. A. Identify the eosinophilic cell indicated by the arrow. Be specific.  
B. It is part of a structure called a/an __________. |
ANSWERS TO QUIZ #6: MUSCLE & NERVE

NOTE: Statements in brackets provide additional information, but that information is not required in order for the answer to be considered correct.

1. Pacinian corpuscle [in cross section. Another Pacinian corpuscle is immediately to its left. Note that during fixation the shape of the corpuscle may sometimes become distorted.]
   Frame 26189

2. Epimysium. [This is the connective tissue layer surrounding the outside of an entire muscle. In Gross Anatomy it would be called the investing fascia of the muscle.]
   Frame 13279

3. Smooth muscle [not nerve. It is cut longitudinally on the left and in cross section on the right. The cells are long and narrow, with a single centrally placed nucleus.]
   Frame 13064

4. Ganglion cell in a sensory ganglion [DRG or sensory cranial ganglion. This is not an autonomic ganglion because the neurons are too large and their nuclei tend to be centrally located.]
   Frame 16577

5. Skeletal muscle [in longitudinal section on the left and cross section on the right. The cells are wide and striated, and have multiple peripheral nuclei.]
   Frame 13345

6. Perineurium. [In skeletal muscle the analogous layer, the perimysium, is not so well defined, and the fascicles tend to be less round.]
   Frame 16431

7. Myenteric ganglion [of the enteric nervous system. The structure contains neurons and is located outside the CNS. Therefore it is a ganglion. The neurons are small and therefore are likely to be autonomic rather than sensory. The ganglion lies between two layers of smooth muscle, and therefore it is a myenteric ganglion.]
   Frame 16800

8. Cardiac muscle. [It has centrally placed nuclei and branching fibers.]
   Frame 14275
9. Peripheral nerve. [Each of these two fascicles contains wavy nerve fibers and many Schwann cell nuclei, and is surrounded by a perineurium. There are no neuronal cell bodies, so it cannot be a ganglion.]
   Frame 16294

10. Intercalated disk. [Typical of cardiac muscle.]
    Frame 14538

11. Schwann cell. [In myelinated nerve fibers the Schwann cell nuclei are located on the exterior surface of the myelin sheath.]
    Frame 16068

12. Meissner’s corpuscle. [It is located in a dermal papilla, and has an oval shape with a layered appearance.]
    Frame 17053

13. Perineurium. [It is a thin, well-defined layer surrounding a longitudinally sectioned nerve fascicle. The wavy nature of the nerve fibers is evident.]
    Frame 16303

14. Perimysium [in skeletal muscle]
   Frame 13580

15. Satellite cell [around a sensory neuron]
   Frame 16523

16. Skeletal muscle [in cross section]
   Frame 13363

17. A. Intrafusal fiber
    B. Muscle spindle
   Frame 13622