Histology

(from the Greek *στός*) is the study of tissue sectioned as a thin slice. It can be described as microscopic anatomy

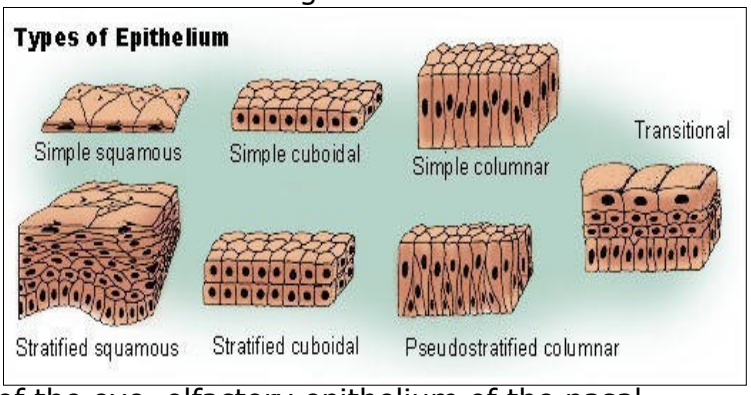
There are many types of tissues in the entire organism. Here we are only going to look at the tissues that pertain to the study of the Equine Hoofcare Professional.

Biological tissue is a collection of interconnected cells that perform a similar function within an organism.

There are **five** basic types of tissue in the body of all animals, including the human body and lower multi-cellular organisms such as insects. These compose all the organs, structures and other contents.

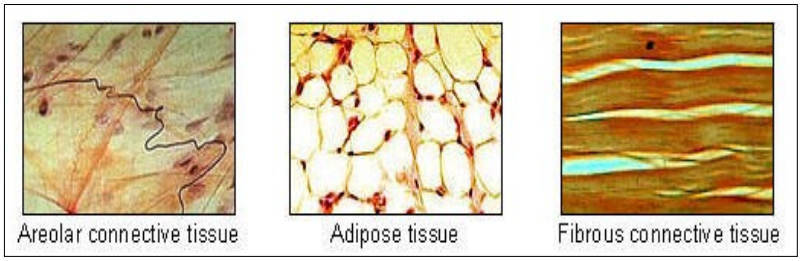
1.) Epithelium

Tissues composed of layers of cells that cover organ surfaces such as the surface of the skin and the inner lining of the digestive tract: the tissues that serve for protection (Examples: Skin, lining of the kidney tubules and respiratory tracts), secretion (sweat, mucus, milk, hormones, wax or enzymes), and sensory (contains nerve endings, like taste buds, retina of the eye, olfactory epithelium of the nasal membranes).



2.) Connective tissue

As the name suggests, connective tissue holds everything together. Some people consider blood a connective tissue. These tissues contain an extensive extracellular matrix.



There are certain characteristics shared by all or most tissues in this category:
Involved in structure and support
Derived from mesoderm (there are exceptions)
Characterized largely by the traits of non-living tissue
Blood, cartilage, and bone are usually considered connective tissue, but because they differ so substantially from the other tissues in this class, the phrase "connective tissue proper" is commonly used to exclude those three. There is also variation in the classification of embryonic connective tissues; here they will be treated as a third and separate category.

Connective tissue proper

Dense connective tissue (or, less commonly, fibrous connective tissue) forms ligaments and tendons. Its densely packed collagen fibers have great tensile strength.

Areolar (or loose) connective tissue holds organs and epithelia in place, and has a variety of proteinaceous fibers, including collagen and elastin. It is also important in inflammation.

Reticular connective tissue is a network of reticular fibers (fine collagen) that form a soft skeleton to support the lymphoid organs (lymph nodes, bone marrow, and spleen.)

Adipose tissue contains adipocytes, used for cushioning, thermal insulation, lubrication (primarily in the pericardium) and energy storage.

Specialized connective tissues

Blood functions in transport. Its extra-cellular matrix is blood plasma, which transports dissolved nutrients, hormones, and carbon dioxide in the form of bicarbonate.

The main cellular component is red blood cells.

Cartilage is in most vertebrates found primarily in joints, where it provides cushioning. The extra cellular matrix of cartilage is composed primarily of collagen.

Bone makes up virtually the entire skeleton in adult vertebrates.

Embryonic connective tissues (this is in here just for completion)

Mesenchymal connective tissue

Mucous connective tissue

Fiber types

Collagenous fibers

Collagen is the main protein of connective tissue in animals and the most abundant protein in mammals, making up about 25% of the total. It is one of the long, fibrous structural proteins whose functions are quite different from those of globular proteins such as enzymes. Strong, tough bundles of collagen called *collagen fibers* are a major component of the extra-cellular matrix that supports most tissues and gives cells structure from the outside, but collagen is also found inside certain cells.

Collagen has great tensile strength, and is the main component of cartilage, ligaments, tendons, bone and teeth.

Along with soft keratin, it is responsible for skin strength and elasticity. It strengthens blood vessels and plays a role in tissue development.

Elastic fibers

The elastic fiber is formed from the elastic microfibril and amorphous elastin. Elastic fibers are found in the skin, lungs, arteries, veins, connective tissue proper, elastic cartilage, and other structures.

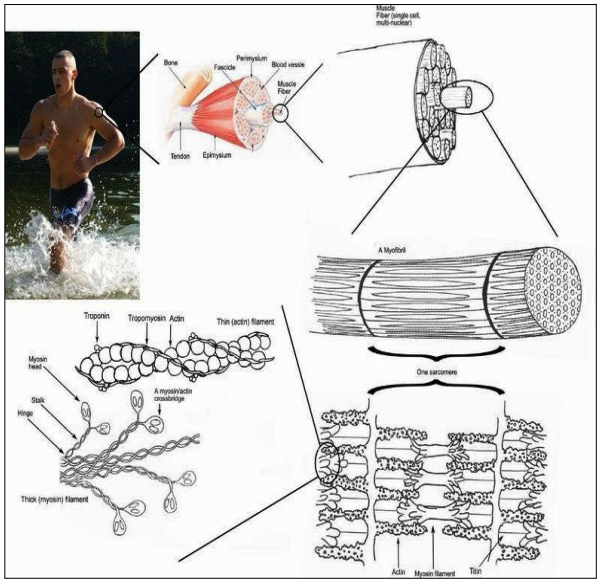
Reticular fibers Are the main structural fiber in some connective tissues. They consists of one or more types of very thin and delicately woven

strands of type III collagen. These strands build a highly ordered cellular network and provide a supporting network. Networks of these fibers make up parts of lymphatic tissues such as the thymus, lymph nodes, spleen, and bone marrow.

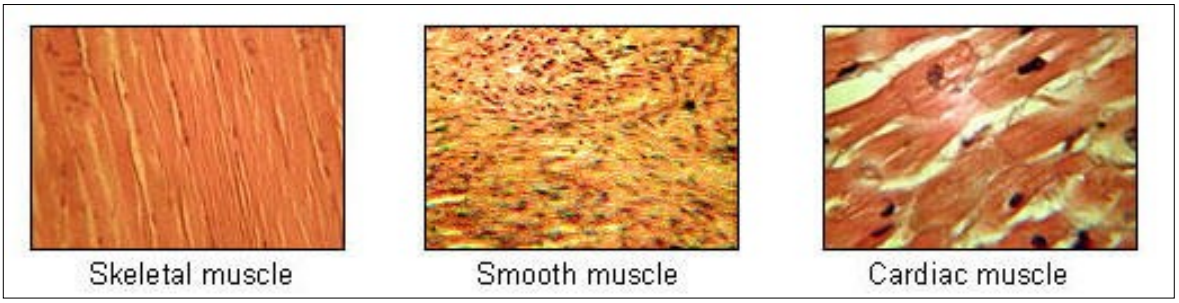
3.) Muscle tissue

Muscle cells contain contractile filaments that move past each other and change the size of the cell

Muscle (from Latin *musculus* "little mouse") is contractile tissue of the body and is derived from the mesodermal layer of embryonic germ cells. Its function is to produce force and cause motion, either locomotion or movement within internal organs. Much of muscle contraction occurs without conscious thought and is necessary for survival, like the contraction of the heart or peristalsis, which pushes food through the digestive system. Voluntary muscle contraction is used to move the body and can be finely controlled, such as movements of the finger or gross movements like the quadriceps muscle of the thigh. Skeletal muscle or "voluntary muscle" is anchored by tendons to bone and is used to affect skeletal movement such as locomotion and in maintaining posture. Though this postural control is generally maintained as a subconscious reflex, the muscles responsible react to conscious control like non-postural muscles.



Smooth muscle or "involuntary muscle" is found within the walls of organs and structures such as the esophagus, stomach, intestines, bronchi, uterus, ureters, bladder, and blood vessels, and unlike skeletal muscle, smooth muscle is not under conscious control.



Cardiac muscle is also an "involuntary muscle" but it's a specialized kind of muscle found only within the heart.

Cardiac and skeletal muscle are "striated" in that they contain sarcomere and are packed into highly-regular arrangements of bundles; smooth muscle has neither. While skeletal muscles are arranged in regular, parallel bundles, cardiac muscle connects at branching, irregular angles. Striated muscle contracts and relaxes in short, intense bursts, whereas smooth muscle sustains longer or even near-permanent contractions.

Skeletal muscle is further divided into several subtypes:

Type I, slow oxidative, *slow twitch*, or "red" muscle is dense with capillaries and is rich in mitochondria and myoglobin, giving the muscle tissue its characteristic red color. It can carry more oxygen and sustain aerobic activity.

Type II, *fast twitch*, muscle has three major kinds that are, in order of increasing contractile speed:
a) Type IIa, which, like slow muscle, is aerobic, rich in mitochondria and capillaries and appears red.
b) Type IIx (also known as type IId), which is less dense in mitochondria and myoglobin. This is the fastest muscle type. It can contract more quickly and with a greater amount of force than oxidative muscle, but can sustain only short, anaerobic bursts of activity before muscle contraction becomes painful (often incorrectly attributed to a build-up of lactic acid).
c) Type IIb, which is anaerobic, glycolytic, "white" muscle that is even less dense in mitochondria and myoglobin.

Anatomy
Muscle is composed of muscle cells (sometimes known as "muscle fibers"). Within the cells are myofibrils; myofibrils contain sarcomeres, which are composed of actin and myosin. Individual muscle cells are lined with endomysium. Muscle cells are bound together by perimysium into bundles called fascicles; the bundles are then grouped together to form muscle, which is lined by epimysium. Muscle spindles are distributed throughout the muscles and provide sensory feedback information to the central nervous system.
Skeletal muscle, which involves muscles from the skeletal tissue, is arranged in discrete groups, examples of which include the *biceps brachii*. It is connected by tendons to processes of the skeleton. In contrast, smooth muscle occurs at various scales in almost every organ, from the skin (in which it controls erection of body hair) to the blood vessels and digestive tract.

Physiology
The three (skeletal, cardiac and smooth) types of muscle have significant differences. However, all three use the movement of actin against myosin to create contraction. In skeletal muscle, contraction is stimulated by electrical impulses transmitted by the nerves, the motor nerves and motoneurons in particular. Cardiac and smooth muscle contractions are stimulated by internal pacemaker cells who regularly contract, and propagate contractions to other muscle cells they are in contact with. All skeletal muscle and many smooth muscle contractions are facilitated by the neurotransmitter acetylcholine.

4.) Nervous tissue
Cells forming the brain, spinal cord and peripheral nervous system.
Nervous tissue is the fourth major class of vertebrate tissue. The function of the nervous tissue is in communication between parts of the body. It is composed of neurons, which transmit impulses, and the neuroglia, which assist propagation of the nerve impulse as well as provide nutrients to the neuron.

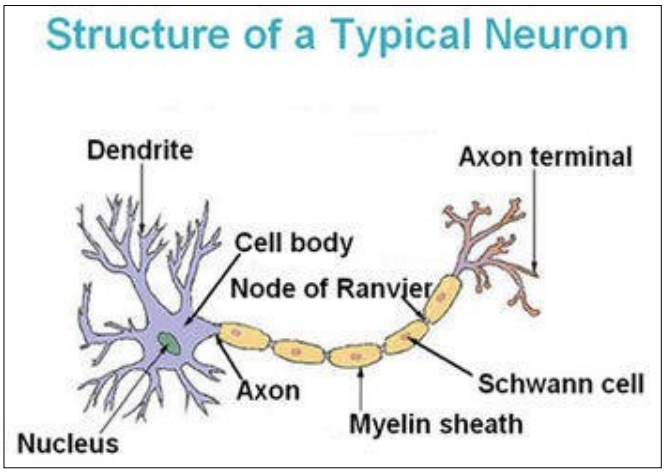
Efferent leg
The efferent leg of the peripheral nervous system is responsible for conveying

commands to the muscles and glands, and is ultimately responsible for voluntary movement. Nerves move muscles in response to voluntary and autonomic (involuntary) signals from the brain. Deep muscles, superficial muscles, muscles of the face and internal muscles all correspond with dedicated regions in the primary motor cortex of the brain, directly anterior to the central sulcus that divides the frontal and parietal lobes.
In addition, muscles react to reflexive nerve stimuli that do not always send signals all the way to the brain. In this case, the signal from the afferent fiber does not reach the brain, but produces the reflexive movement by direct connections with the efferent nerves in the spine. However, the majority of muscle activity is volitional, and the result of complex interactions between various areas of the brain.
Nerves that control skeletal muscles in mammals correspond with neuron groups along the primary motor cortex of the brain's cerebral cortex. Commands are routed though the basal ganglia and are modified by input from the cerebellum before being relayed through the pyramidal tract to the spinal cord and from there to the motor end plate at the muscles. Along the way, feedback loops such as that of the extra-pyramidal system contribute signals to influence muscle tone and response.
Deeper muscles such as those involved in posture often are controlled from nuclei in the brain stem and basal ganglia.

Afferent leg

The afferent leg of the peripheral nervous system is responsible for conveying sensory information to the brain, primarily from the sense organs like the skin. In the muscles, the muscle spindles convey information about the degree of muscle length and stretch to the central nervous system to assist in maintaining posture and joint position. Sometimes known as muscle memory,

the sense of where our bodies are in space is called Proprioception, the perception of body awareness. More easily demonstrated than explained, Proprioception is the "unconscious" awareness of where the various regions of the body are located at any one time. This can be demonstrated by anyone closing their eyes and waving their hand around. Assuming proper proprioceptive function, at no time will the person lose awareness of where the hand actually is, even though it is not being detected by any of the other senses.
Several areas in the brain coordinate movement and position with the feedback information gained from Proprioception. The cerebellum and nucleus rub in particular continuously sample position against movement and make minor corrections to assure smooth motion.
Neurons are highly specialized and differ widely in their appearance and electrochemical properties. These differences include the cellular extensions known as *processes* which neurons use to send and receive information. Neurons' size also varies, depending on the type of neuron and the animal species it is from. Typical neurons are 4 to 100 micrometers in diameter.



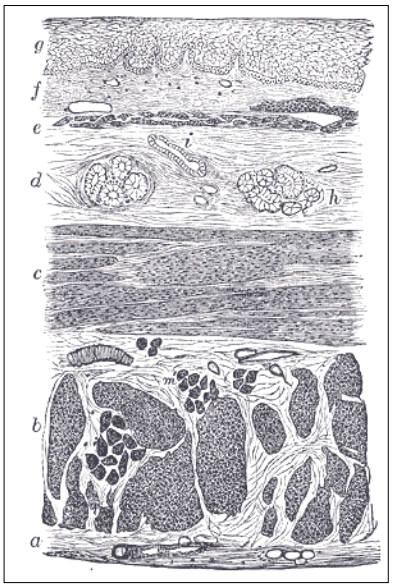
The soma, or 'cell body', is the central part of the cell, where the nucleus is located and where most protein synthesis occurs.
The nucleus ranges from 3 to 18 micrometers in diameter.
The dendrite is a branching tree of cellular extensions. Most neurons have several dendrites with profuse dendritic branches. The overall shape and structure of a neuron's dendrites is called its *dendritic tree*, and is traditionally thought to be the main information receiving network for the neuron. However, information outflow (i.e. from dendrites to other neurons) can also occur.
The axon is a finer, cable-like projection which can extend tens, hundreds, or even tens of thousands of times the diameter of the soma in length. The axon carries nerve signals away from the soma (and also carries some types of information back to it). Many neurons have only one axon, but this axon may - and usually will - undergo extensive branching, enabling communication with many target cells. The part of the axon where it emerges from the soma is called the 'axon hillock'. Besides being an anatomical structure, the axon hillock is also the part of the neuron that has the greatest density of voltage-dependent sodium channels. This makes it the most easily-excited part of the neuron and the spike initiation zone for the axon: in neurological terms it has the greatest hyperpolarized action potential threshold. While the axon and axon hillock are generally involved in information outflow, this region can also receive input from other neurons as well.
The axon terminal is a specialized structure at the end of the axon that is used to release neurotransmitter chemicals and communicate with target neurons. Although the canonical view of the neuron attributes dedicated functions to its various anatomical components, dendrites and axons often act in ways contrary to their so-called main function.

Axons and dendrites in the central nervous system are typically only about a micrometer thick, while some in the peripheral nervous system are much thicker. The soma is usually about 10–25 micrometers in diameter and often is not much larger than the cell nucleus it contains. The longest axon of a motoneuron can be over a meter long, reaching from the base of the spine to the toes. Giraffes have single axons several meters in length running along the entire length of their necks. Much of what is known about axonal function comes from studying the squid giant axon, an ideal experimental preparation because of its relatively immense size (0.5–1 millimeters thick, several centimeters long).

5.) Areolar connective tissue

A pliable, mesh-like tissue with a fluid matrix that functions to cushion and protect body organs.

Areolar connective tissue (or **loose connective tissue**) is the most widely distributed connective tissue type in vertebrates.



Location

It can be found in the skin as well as in places that connect epithelium to other tissues.
The areolar tissue is found beneath the dermis layer and is also underneath the epithelial tissue of all the body systems that have external openings.
It is also a component of mucus membranes found in the digestive, respiratory, reproductive, and urinary systems.
It also surrounds the blood vessels and nerves.

Composition

It is a pliable, mesh-like tissue with a fluid matrix and functions to cushion and protect body organs.
Cells called fibroblasts are widely dispersed in this tissue; they are irregular branching cells that secrete strong fibrous proteins and proteoglycans as an extra cellular matrix.
The cells of this type of tissue are generally separated for quite some distance by a gel-like gelatinous substance primarily made up of collagenous and elastic fibers.

Function

It acts as a packaging tissue holding the internal organs together and in correct placement.
t holds organs in place and attaches epithelial tissue to other underlying tissues.

Classification

Loose connective tissue is named based on the "weave" and type of its constituent fibers. There are three main types:
Collagenous fibers: collagenous fibers are made of collagen and consist of

bundles of fibrils that are coils of collagen molecules.
Elastic fibers: elastic fibers are made of elastin and are "stretchable."
Reticular fibers: reticular fibers consist of one or more types of very thin collagen fibers. They join connective tissues to other tissues.

UNO

ALLA

VOLTA—

ONE

AT

A

TIME