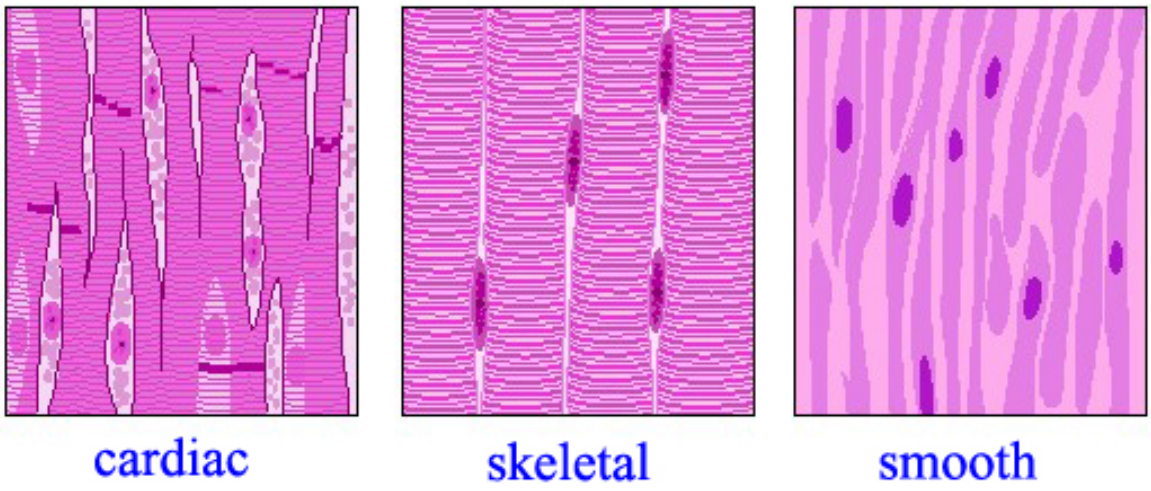
Organization of the Muscular System

Introduction

There are over 600 muscles in the human body. In BIOL 223, you are expected to learn upwards of 350 of these muscles. In BIOL 204, we'll gloss over about 60 or so of the "more popular" muscles, i.e., mostly superficial muscles.

Before we jump into the muscular system on a macroscopic level, let's review (there will be no microscopic portion to this experiment as you've already examined the 3 types of muscle in an earlier lab) the three types of muscle tissue: Skeletal, Smooth and Cardiac. The graphic, below, illustrates the 3 kinds of muscle tissue:



Skeletal muscle is attached to bones via tendons (ligaments connect bones to each other; tendons connect bones to muscle). It is striated due the presence of bands. This muscle is voluntary, i.e., it is under conscious control.

Smooth muscle is also known as visceral muscle. It is found around the walls of hollow organs, e.g., blood vessels, stomach, bowel. It is NOT under conscious control and is non-striated.

Cardiac muscle is found in the walls of the heart. It is striated and is involuntary.

Skeletal muscle is the tissue-type we'll deal with – on a macroscopic scale – in this experiment. Skeletal muscle has very distinct macroscopic features. To summarize these succinctly, the muscle contracts in the same direction as that of the fibers. In order for contracted muscle to have an effect on movement, the muscle must be attached across a joint. Muscles are attached by tendons to the periosteum of the bone which is attached to the bone. When dealing with muscles, you'll want to remember that there are three parts to a muscle: the origin, the insertion and the belly. The belly of the muscle is pretty self-explanatory: it's the fleshy part we feel when we make a muscle. The origin is the immovable part of the muscle and is, generally, the region to which the muscle moves when it contracts. The insertion is the movable part of the muscle and is, generally, the region away from which the muscle moves when it contracts.

- Origin: this is the IMMOVEABLE side of the joint and tends to be the upper attachment of the muscle to the bone.

- Insertion: this is the MOVEABLE side of the joint and tends to be the lower attachment of the muscle to the bone.

As a general rule, insertions are above origins – there are exceptions, but we're not gonna worry about it until you look at the muscles. Lastly, and MOST importantly, muscles PULL -- they do NOT push!

In order for bones to move, they must be organized around/across joints. Joints are held together by ligaments. Joints are the moving part of the organization, but require something to move the bones to effect a movement. That "something" is the muscles of the body. By and large, we move via a system of levers. For all intents and purposes, we have three types of levers in our bodies: Class I, Class II and Class III levers, previously studied in the Articulations' experiment.

In a Class I lever, the fulcrum is between the load and the moving force. A good example of this in real life is a teeter-totter. In the body, an example of this sort of lever is hyper-extending the head on the neck.

In a Class II lever, the load is between the fulcrum and the moving force. A real life example is a wheelbarrow. An example in the human body is plantarflexing the foot as you stand on your tippy toes.

In a Class III lever, the moving force is between the fulcrum and the load. A real life example of this sort of lever is carrying a loaded shovel. An example in the human body is drinking from a mug as you bring it from the table to your mouth.

In order to have movement, the muscle contracts (shortens) and PULLS the insertion end of the muscle towards the origin end to move the joint in purposeful action. Muscles PULL – they do NOT push! In order to return the joint to its original position, another set of muscles (called antagonists) contracts while the first set relaxes. Two examples of an antagonistic set of muscles are the biceps brachii/triceps brachii and quadriceps/hamstrings.

Nerves and arteries tend to follow the muscles either along side of the muscles or slightly deep to the muscles. Veins – of interest to health care providers – tend to overlay the muscles superficially. Nerves provide the electrical signals to cause muscles to contract. Arteries carry oxygenated blood away from the heart to nourish the tissues in the body. Veins carry deoxygenated blood to the heart with waste products from the tissues.

The primary muscles of interest to the health care provider include all of the muscles of the human body that assist in locating a vein, an artery or a nerve – locomotion, kinesiology, levers, are of great importance, as well. In the case of veins and arteries, they are important for blood sampling; nerves, of course, are significant so that they are not severed causing paralysis, at the worst, to a specific region of the body.

Muscle tissue makes up 40-50% of your total body weight. Muscle tissue has 4 big characteristics: irritability, contractility, extensibility and elasticity. Irritability is the ability of the tissue to receive and respond to stimuli. Contractility is the ability to shorten and thicken after sufficient stimulus. Extensibility means that it can be stretched. Elasticity is the ability of the muscle to return to its original shape after contraction/extension.

The physiology of muscle tissue is motion, posture maintenance and heat production (thermogenesis). Obvious motions include walking, running, locomotion. This relies on the integrated functioning of bones, joints and muscles attached to bones. Less noticeable motions include your heart beating, your stomach wiggling, peristalsis, your gall bladder contracting and the contraction of your urinary bladder.

Contractions of the muscles hold the body in stationary positions, e.g., sitting, standing, to maintain your posture. You learn those positions as you develop from a newborn to a toddler.

Skeletal muscle contractions produce heat and are important in maintaining normal body temperature. This body temperature maintenance comes about through shivering and during exercise. The production of heat is called thermogenesis.

When talking about skeletal muscle tissue, we must also discuss fasciae (FAH shuh). Fasciae is a sheet or broad band of fct (fibrous connective tissue) beneath the skin or around muscles and other organs of the body. There are three types: superficial, deep and subserous.

Superficial fascia is aka the subcutaneous layer. It is immediately deep to the skin. It is thin on the back of the hand. It is thick over the inferior abdominal wall. The outer layer of this tissue is adipose (fat) tissue and the inner layer is reticular tissue. Between the inner and outer layers, arteries, veins, nerves, mammary glands and facial muscles are found.

Deep fascia is the most extensive of the three. It is made up of dense connective tissue -- NO fat. It lines the body walls/extremities and holds muscles together to form functioning and/or compartmentalized groups.

Subserous fascia is between the internal deep layer of the deep fascia and a serous membrane. It covers the external surfaces of viscera in the thoracic and abdominal cavities.

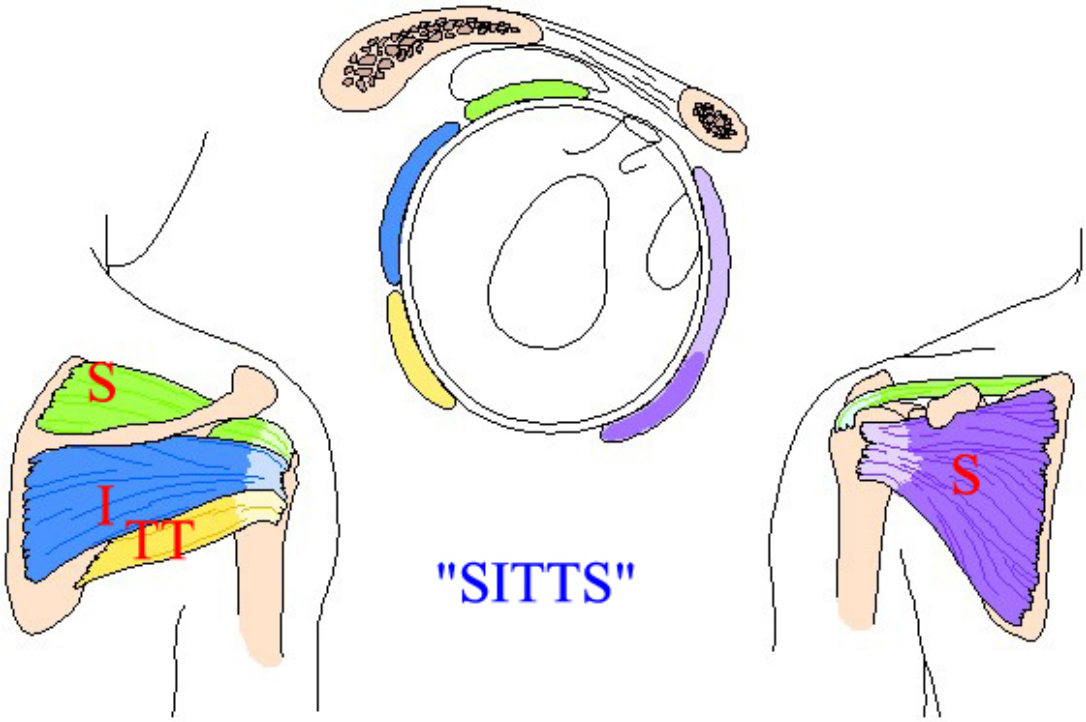
Specific Muscle Groups

Because there are some surgical procedures that are fairly common that involve specific regions of the body, let's take a few minutes and go over these areas – these areas are not inclusive and do not take into account "popular" kinds of procedures.

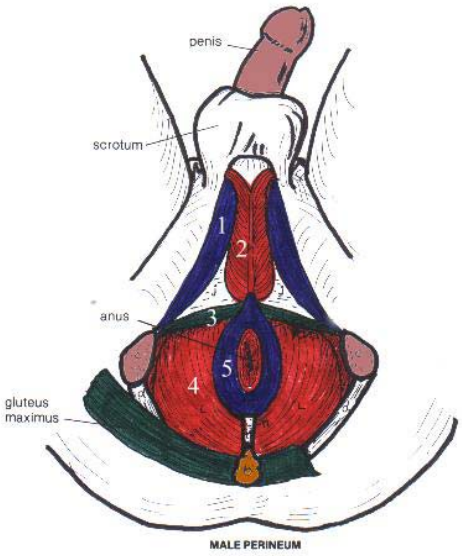
The first has to do with rotator cuff injuries – the techniques and methods are left to those who do it for a living. Below, though, is a graphic of the rotator cuff under normal circumstances:

The mnemonic "SITTS" stands for the muscles that are involved in the cuff. They stand for Supraspinatus, Infraspinatus, Teres minor, Teres major (there is not 100% agreement on this one)

and the Subscapularis. The graphic, below, illustrates the posterior, lateral and anterior view of the rotator cuff, respectively.



With the increase in longevity in males, it's necessary to have a working knowledge of the superficial musculature of the perineum. The graphic, below, illustrates the male perineal musculature:

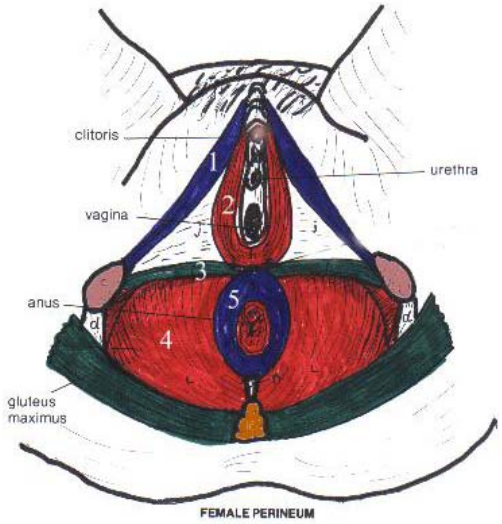


The table, below, summarizes the muscles and their functions.

Muscle name	Origin	Insertion	Action
1. Ischiocavernosus	Ischial tuberosity, crus penis, ischial ramus	Sides and the under surface of the crus penis (the portion of the penis that is directly attached to the inferior ramus of the os pubis that is partly responsible for erection of the penis)	Maintains erection due to compressing the crus, retarding the outflow of blood from the penis; aka erector penis
2. Bulbospongiosus	Perineal raphe (the "seam" between the scrotum and the anus)	Corpus cavernosum, corpus spongiosum and os pubis	To empty the urethral canal after micturition; erection of the penis (compresses corpus spongiosum -- another erectile tissue in the penis); aka accelerator urinae
3. Transversus perinae	Ischial tuberosity	Perineal raphe	On contraction, fixes the raphe

4. Levator ani	Posterior os pubis	Apex of coccyx, rectum, side of prostate	Supports lower end of rectum and bladder during expulsion
5. External anal sphincter	Tip and back of coccyx	Perineal raphe	Keeps anal orifice closed; may be tightened voluntarily in expiration

It is also important to have a handle on the female perineal musculature. The graphic, below, illustrates the female perineal musculature of a superficial nature:



The table, below, summarizes the muscles and their action.

Muscle name	Origin	Insertion	Action
1. Ischiocavernosus	Ischial tuberosity and ramus; clitoral crus (equivalent of crus in the male, only at the proximal end of the clitoris)	Crus clitoris	Resembles erector penis in male; maintains organ erection; aka erector clitoridis
2. Bulbospongiosus	External sphincter ani	Corpora cavernosa of clitoris to compress dorsal vein	Analogous to accelerator urinae in male; decreases size of vaginal orifice; clitoral erection (aka sphincter vaginae)
3. Transversus perinae	Ischial tuberosity	Central point of perineum; external sphincter ani and sphincter vaginae	On contraction, fixes the central part of the perineum

4. Levator ani	As above	As above, less the prostate, of course	Supports lower end of rectum and vagina and bladder during expulsion
5. External anal sphincter	Tip and back of coccyx	Tip and back of coccyx	As above

The female perineum has invited all sorts of unique issues. For years, episiotomies were routinely performed during childbirth. This practice has been challenged on a number of scientific principles (http://www.efn.org/~djz/birth/obmyth/epis.html). Additionally, for many years, delivering physicians would add an additional stitch or two when suturing the episiotomy incision to "tighten" the introitus for coitus. This caused many women to have painful intercourse and the practice is not as common as it once was. As more and more women get into the field, male dominated practices – for the sake of males – are going by the wayside.

Experimental

BIOL 204

Using your texts and your lecture notes, use the models, charts and cadavers to identify and locate the common superficial muscles.

BIOL 223

Using your texts, your lecture notes, your Gray's, the models, charts and cadavers, identify as many muscles as we discussed in lecture.

Both Groups

Label the following three (3) muscular diagrams in as much detail as possible.