

Teaching About Muscles

Are Your Students Flexing Their Minds As They Extend Their Knowledge?

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It is common for many high school biology teachers to require their students to memorize the major muscles of the human body. Often students are supplied with a chart depicting a prototypical muscular male (sans integument) with the muscles labeled by their polysyllabic Latin names. The students are asked, first, to learn the names of most of the muscles, and then to identify these names and muscles later during a quiz or test.

After many years of this practice, I stopped and thought about the value of this common exercise. Other than "quads," "pecs," "abs," "biceps" and "triceps," which my students could have identified beforehand, what educational value did this exercise provide? What unifying principles of musculoskeletal structure and function did this exercise teach? How many students (athletes excepted) could relate any of these names to the functioning of their own bodies? After thinking about these issues, I hit upon a novel way to teach about the musculoskeletal system in a way that is immediately relevant to students and engages them physically, verbally and intellectually.

I have my students actually ex-

ercise individual muscles or small groups of muscles to try to determine which muscles are involved, and their approximate origins and insertions. I ask each class to meet me in our high school's exercise room which is equipped with a typical array of Nautilus and Universal exercise machines, plus free weights. On hand are:

1. A wall chart of the human musculature, front and back views
2. A human skeleton or a wall chart of the same
3. Human anatomy reference

books or texts such as *Gray's Anatomy*

4. Numbered signs affixed to the exercise stations that I want the students to use.

I select exercise machines and free weights that tend to work isolated groups of muscles. These machines are:

1. Lower leg extension (Figure 1)
2. Lower leg flexion
3. Bench press
4. Military (overhead) press
5. Pulldown (Figure 2)
6. Rowing
7. Arm curls (Figure 3).



Figure 1. The leg extension machine works the quadriceps muscle group of the thigh.

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The guidelines and instructions for the class need to be clearly stated at the outset. I divide up the class into a convenient number of groups relative to the number of available stations. I preset the machines to a low-weight setting, prohibit readjusting the amount of weight used, and quickly demonstrate how each machine is used. Each group will eventually work at each station with each student in a group performing several repetitions of each exercise. As the students are using each machine, the other group members can attempt to pinpoint the general location of the muscle(s) in use.

A hint that struggling students find helpful in locating an active muscle is that the muscle which is in use will tighten and bulge. This tightening can be felt manually by placing one's palms on the suspected muscle while it is in use. This may seem obvious to the initiated, but it is worth mentioning to your students who are usually reluctant to touch each other. In general, I encourage group members to touch and feel the muscles that are being used. In most cases, this "hands-on" investigation of muscle function is taken seriously by everyone except the most ticklish. While you are free to structure your groups as you wish, I prefer to match males with males and females with females because of the amount of touching that occurs.

As a group finishes at a station, they consult the aforementioned reference materials to determine which muscle(s) are involved and which bones these muscles are attached to. It is rewarding to oversee the students' discussions (and arguments) that accompany this part of the analysis. It is now that I introduce terms such as flexor, extensor, origin and insertion. My role is that of facilitator, helping to direct the discussion and reminding or teaching the basic functional principles of the musculoskeletal



Figure 2. The "pull down" works the biceps and the latissimus dorsi muscles.

system. While I do simplify many ideas, I am also sure to stress that the system does not function with the simplicity of an erector set; if it did, our muscles and bones would not be capable of such a remarkable number of different motions.

The trapezii muscles of the upper back will serve as an example. The trapezius is a triangular sheet of muscle that originates extensively from the occipital bone of the skull, along the cervical vertebrae, and along the spinous pro-

cesses of the thoracic vertebrae. Though not as lengthy as the origin, the insertion of the trapezius is still far from simple, with fibers inserting into the posterior surface of the clavicle (collar bone) and along the acromion and spinous processes of the scapula (shoulder blade). After pointing out these locations to my students, I explain that the trapezius, while it is named as a single muscle, actually functions by itself as a set of many muscles. For example,



Figure 3. "Curls" work the biceps.

during the rowing exercise, the trapezii pull the shoulders straight back. When we shrug our shoulders, the trapezii pull them closer to our ears. When we puff out our chest while attempting to stand at attention, the trapezii pull our shoulders backwards and slightly downwards. In each of these examples, different groups of fibers within the trapezii become active.

I treat other muscles, such as the triceps, the pectorals, and the quadriceps group, more simply than the trapezius even though they also have complex origins or

insertions. Except for the key words mentioned above (flexor, extensor, origin and insertion), I do not overwhelm students with nomenclature or complexity at the expense of basic principles. I feel that the processes of observing, discussing, researching, modeling, drawing conclusions, and making predictions are the aim of this lesson.

If you try this lesson, I believe that your students will gain a lasting insight into how their muscles function. This exercise, which can last two periods, can serve as a springboard into the finer points

of muscle physiology such as motor units (composed of a neuron and associated muscle cells) and the cellular basis of contraction. You will find that this exercise presents a number of worthwhile possibilities.

[A word of advice on planning: Be sure to consult with your school's athletic director, physical education teacher or other concerned personnel regarding the availability of the space and use of the equipment. It also helps to post a sign reserving the exercise room once you have obtained clearance to use the facility.]

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