The Power of Exercise

Dear Human Resources Department at Lifetime Fitness,

We appreciate your consideration for the position of personal trainer at your facility in Pine City, MN. We have a love for fitness and have an extensive background in muscle anatomy and physiology. We believe that exercise is an important aspect of achieving or maintain optimum health. When we exercise we are not only targeting the muscle groups we use for a specific exercise, it also affects the cardiovascular system, respiratory system and skeletal system. Because these different body systems are affected, we think it is important to know how the muscles work so we can give our bodies the proper nutrition it needs.

For example, an exercise that is great at targeting multiple muscles at one time is squats. Four of the main muscles that are used during this workout are the Rectus Femoris, Vastus Lateralis, Vastus Medialis, and Vastus Intermedius. This group of muscles, which are called Quadriceps Femoris are responsible for leg extension at the knee. Rectus Femoris has an additional action in which it is involved in hip flexion since its origin starts at the anterior inferior iliac spine (Martini & Nath, 2010, p. 371).

During squats, these four muscles contract eccentrically during the downward-movement period and concentrically during the upward-movement phase (LIVESTRONG Foundation, 2014). This process of contraction cannot be done without help from the Biceps Femoris, Semimembranosus, and the Semitendinosus which are antagonists of the Quadriceps Femoris. All three of these muscles provide flexion at the knee.

Maintaining a workout that includes squats will help develop the Quadriceps Femoris, among several other skeletal muscles. Repetition will result in stronger and larger quadriceps which will help in limiting injury to these muscles, along with the capability of lifting more weights during squats. Other benefits include, improved balance, increased mobility, and an increase in physical activity like running and jumping (Mercola, 2014).

Although performing squats will help strengthen your leg muscles, particularly the quadriceps, other body systems like your cardiovascular system will also be affected. Regular muscle contraction can result in improved circulation of blood to your muscles and an increase in your muscle temperature. Over time, with regular training changes occur both in your muscular system and your skeletal system. One of the most important changes is an increase in the width and density of your bones. This increase can significantly reduce your chances of bone-related injuries, such as fractures. An increase in bone density will also help decrease the risk of osteoporosis (LIVESTRONG Foundation, 2014).

While it is important to know why exercise is important and what muscles we are using when we are performing squats, we think it is also beneficial to know what makes up a skeletal muscle and how the muscle itself actually works.

Skeletal muscles are connected to bone by tendons or tendon sheets called aponeurosis. The entire muscle itself is covered by a connective tissue called epimysium. Inside the muscle are many smaller bundle like units that run the length of the muscle called fascicles. Each fascicle is covered in connective tissue called perimysium. Inside each of the fascicles are smaller bundle like units that also run the length of the muscle called muscle fibers. These fibers are covered in connective tissue

called endomysium. These structures are covered by sarcolemma and are filled with sarcoplasm. Within the sarcoplasm are even smaller bundle like units called myofibrils which are surrounded by the sarcoplasmic reticulum. The myofibril is made up of units called sarcomeres. Each sarcomere is made up of thick fibers call myosin and thin fibers called actin. The sarcoplasmic reticulum forms a network like frame made from tubes called T-Tubules. On both sides of the T-tubules are formed chambers called terminal cisternae (Martini & Nath, 2010, pp. 244-245).

When your muscles move, or contract, there are many things that happen within the muscle cell or tissue to make this movement happen. One way to explain how muscle contraction happens is though the sliding filament theory. This theory was published in 1954 describing the molecular basis of muscle contraction by scientists A. F. Huxley, R. Niedergerke, H. E. Huxley, and J. Hanson. By using a high-resolution microscope they examined what happens in the sarcomere (Nature Education, 2014).

In this theory the myosin, which is made up of thick filaments (fibers) was labeled the A band did not move, and the actin which is made from thin filaments (fibers) was labeled the I band got smaller and moved to the middle of each sarcomere. The I band moves over the top of the A band using a sliding motion, hence the name The Sliding Filament Theory (Martini & Nath, 2010, p. 248).

The sliding of the actin over the myosin is just part of how the muscle contracts. Many other reactions take place to in order to make these fibers move. It all starts with a message sent from the brain down nerves telling the muscle to contract.

A signal, called action potential, is sent down a neuron. It opens a chemically gated channel allowing calcium to enter the neuron. The calcium signals the neurotransmitters, in this case

Acetocholine (Ach), to leave the end of the neuron called the synaptic knob. Ach is released into the space between the synaptic knob and the muscle cell called the synapse. The Ach then triggers more chemically gated channels on the muscle cell to open at what is called the motor end plate. Once these channels are open they allow sodium to enter the cell causing local depolarization. If the local depolarization is great enough, action potential is sent down the length of the muscle cell causing a domino effect and opening voltage gated channels which allow more sodium into the cell and also potassium to leave the cell. The action potential allows sodium to enter and potassium to leave the cell all the way down the sarcolemma and T-tubules. When this action potential goes down the T-tubules it releases calcium which is stored in the cisternae into the sarcoplasm (Grinde, 2014).

As previously stated the sarcoplasm is where the actin and myosin fibers are located. The calcium binds to the actin fibers on what is called the troponin. This causes the tropomyosin on the actin to move and it reveals a binding site. These binding sites, or cross bridges, are where the "heads" of the myosin attach causing the head to flex, or contract. When the myosin head flexes it move the actin fiber inward causing it to shorten. Adenosine triphosphate, or ATP, is used to break the bond and the myosin head attaches to the next binding site on the actin and moves it inward over the top of the myosin causing a sliding filament and shortening the fibers for muscle contraction (Grinde, 2014).

ATP, which is our body's form of energy is not only used to break the bond between the myosin head and the binding site of the actin, but it also used to restore the chemical balance in the muscle cells needs when it is at rest. After the voltage gated channels close down the length of the sarcolemma on the muscle fiber, ATP is used to take the extra sodium out of the cell and bring the potassium back into the cell by using the Sodium/Potassium Pump. For every one ATP three sodium

ions move out of the cell and two potassium ions move back into the cell (Grinde, 2014).

I hope we have provided you with enough information needed to prove to you why we would be great additions to your personal trainer team. We look forward to hearing from you regarding this employment opportunity.

References

Grinde, A. (2014, March 18). Easy Steps of Muscle Contraction. Pine City, Minnesota, USA: Lecture.

LIVESTRONG Foundation. (2014, April13). *LIVESTRONG.com.* Retrieved from http://livestrong.com

Martini, **F. H.,** & Nath, J. L. (2010). *Anatomy* & *Physiology, Second Edition.* San Fransicso: Pearson Education, Inc.

Mercola, J.D. (2014, April B). Retrieved from Mercola Peak Fitness: http://fitness.mercola.com

Nature Education. (2014, April14). Retrieved from Scitable: http://www.nature.com/scitable/topicpage/the-sliding-filament-theory-of-muscle-contraction-14567666

Work Sample Evaluation

Subject Area: Anatomy & Physiology
Task Title: The Power of Exercise
Student Work Sample Title: The Power of Exercise

The document was scored using the *CCR Task Bank Rubric*. The final scores are indicated in the following chart.

Scoring Criteria	Insufficient Evidence	Developing	Progressing	Accomplished	Exceeds
Research and Investigation				**X**	
Ideas and Content				**X**	
Reading and Analysis			**X**		
Communication				**X**	
Organization			**X**		
Accuracy			**X**		

Annotations: The following evidence from the work sample and the reviewer's comments support the scores above. Page and line numbers refer to the original work sample.

Scoring Criteria	Page #	Line #	Commentary about the work sample
Research and Investigation: *Locating resources independently and/or identifying information within provided texts*	6	2-8	The references include one textbook, one book, and three websites.
			All references were cited within the body of the paper.
Ideas and Content: *Presenting a thesis and understanding concepts*	1		A coherent thesis is present, however the work sample could have aligned material a little better to improve the flow of the document.
	1	13-18	The student provides a good description of quadriceps femoris muscle group.
	1-2	19-5	Good description of the actions of quadriceps femoris muscle group.
	2	6-13	The student makes good links between the muscular system and the health of cardiovascular and skeletal systems.
	2-3	17-6	Student provides a good technical description of skeletal muscle structure.
	3-4	15-8	The section on nervous impulse conduction could have been introduced earlier so that the reader does not have to return to the section on muscle contraction in order to understand this.
	4	9-15	A good description of troponin/tropomyosin and the way it operates.
	4	16-21	Since the description of ATP is a major requirement of the paper, the description of the term should be more than five sentences.
Reading and Analysis: *Evaluating sources and selecting evidence to support the central idea*	2-3	17-6	The student provides a very technical description of skeletal muscle structure, however no attempt was made in using the information from source material and evaluating it properly.
	6	2-8	Two of the three websites are not scientifically accurate enough to write a paper on skeletal muscle contraction. While the student did the research and investigation, the student's level of reading and analysis is at the progressing level.
Communication: *Using subject-appropriate language and considering audience*	1	4-12	Since the target audience is a Fitness Club, the language utilized in the paper is appropriate.
	1	13-18	The student uses the complete names of the skeletal muscles within their paper.
	2-3	17-6	The work sample includes all of the correct terms associated with skeletal muscle fiber structure.

Scoring Criteria	Page #	Line #	Commentary about the work sample
Organization: *Structuring main ideas and supporting information*			According to the directions for this paper, skeletal muscle structure and sliding filament theory were to be discussed first followed by the selected exercise and muscle group. The student did the opposite, which affected the transitions within the paper.
	5	2-4	The closing paragraph is clumsily written.
Accuracy: *Attending to detail, grammar, spelling, conventions, citations, and formatting*	1	8	The use of verb tense changes within this sentence.
			The student could have paid more attention to grammar. Small errors throughout don't interfere with the message, but would be received poorly by the potential employer.