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Lab: The Muscular System

Background Information

The Muscular System

The main function of the muscular system is movement. This includes walking, breathing, pumping of the heart, and moving food through your digestive tract, just to name a few important examples. Muscles also create heat as they contract, helping to maintain a constant body

temperature. Muscle tissue makes up nearly half of a individual's total body weight. Each muscle is an individual organ made up of muscle tissue, nerves, blood vessels, and conntective tissue. There are 3 types of muscle tissue: skeletal, cardiac, and smooth.

Skeletal Muscle

Approximately 650 skeletal muscles are attached to bones by tendons. Skeletal muscles contract voluntarily, meaning that you can control them consciously. Skeletal muscle cells appeart to be striped under the microscope, and these stripes are called striations. Most skeletal muscles are attached to two bones over a joint. When they contract, they pull the attachment points closer to one another.

Tendons are made up of extremely tough collagen fibers in the form of dense connective tissue. They attach to skeletal muscle fibers on one side and are intermeshed in bone on the other. Tendons must handle a great degree of strain when a muscle contracts. When identifying skeletal muscles and their function, the location, origin, and insertion points are important. The location is the area of the



http://biology-forums.com/gallery/14755_30_09_12_4_31_30_89891069.jpeg

body where the muscle is found, the origins is the point where the muscle connects to a stationary bone, and the insertion is the point where the muscle connects to a moving bone.

Cardiac Muscle

Cardiac muscle is only found in the heart and continuously contracts and relaxes to push blood through the blood vessels and body. Cardiac muscle contracts involuntarily, meaning that a person cannot control when they contract. The heart has its own pacemaker that initiates the consistent contraction of cardiac tissue. Cardiac muscle tissue is striated like skeletal muscle, but also has areas called intercalated discs. These disks are areas where cells interlock to form very tight



bonds, allowing cardiac muscle tissue to withstand a great amount of pressure and force over an individual's lifetime.

Smooth Muscle

Smooth muscle, also known as visceral muscle, is the weakest of the muscle tissues and is found within organs. Smooth muscles also contract involuntarily. They can be found linking blood vessels, the gastrointestinal tract, and the bladder. When smooth muscle contracts it moves substances, such as blood or food, through the organ.

Skeletal Muscle Structure

Muscle cells, also known as myofibers, are specialized to contract and therefore look very different from neurons or skin cells. The cell membrane of a muscle cell is called the sarcolemm, and the cytoplasm is called the sarcoplasm. Hundreds of long filaments, called myofibrils, extend the length of the cell. Each myofibril is made up of think filaments, called myosin, and thin filaments, called actin, that are responsible for the actual muscle contraction. The arrangement of these



filaments gives skeletal muscle is striated appearance. An entire muscle is actually made up of bundles of muscles cells held together by connective tissue.

Muscular Disorders

Normal muscle function is crucial to overall health. A variety of abnormalities caused by disease or disorders can affect the ability of muscles to contract to perform daily functions. For example, paralysis of the diaphragm muscle would prevent respiration and result in death. The following table summarizes a few neuromuscular disorders. Prevalence and mortality is based on annual numbers from 2009 in the U.S.

| Muscular Disorder | Description Symptoms | | Prevalence | Annual Mortality Rate |
|---|--|--|------------------------------|-----------------------------|
| Muscular dystrophy (MD) | Genetic disease that damages the muscle fibers; 9 different forms | Muscle weakness, lack of coordination and mobility | 1 in 6,000 males 5-24 y/o | 45% by age 24 |
| Cerebral palsy | Injury or abnormality to the brain that results in a disconnect between the brain and muscle movement Spastic paralysis, muscle tightness, abnormal gait, joint contracture, seizures | | 1 in 278 | 8,000 |
| Myasthenia gravis | Autoimmune disease that causes Hemi-paralysis, muscle muscle weakness weakness, 1 ir | | 1 in 20,000 | N/A |
| Amyotrophic lateral sclerosis (ALS) | AKA Lou Gehrig's Disease; gradual Muscle impairment, degeneration of motor neurons atrophy, weakness, and eventually paralysis | | 2 in 100,000 | 4,000 |
| Fibromyalgia | Pain and tenderness of the muscles, joints, and soft tissues | rness of the muscles, Fatigue, headaches, 1 in 50 nd soft tissues muscle pain, joint pain | | N/A |
| Myositis | Inflammation of the skeletal muscles caused by an infection | Muscle weakness, rash, fatigue, difficulty breathing | | N/A |

Station 1: The Muscle Structure

Muscle Structure

Using the "Muscle Structure" chart, identify and label the selected structures in Table 3 below. You can use your lecture notes and textbook to help you with identification. A larger version of this picture is available on the lab table.

TABLE 1: Muscle Structure

| Α. | К. |
|----|----|
| В. | L. |
| С. | M. |
| D. | N. |
| E. | О. |
| F. | Ρ. |
| G. | Q. |
| Н. | R. |
| Ι. | 5. |
| J. | T. |



Muscle Contraction

Using the chart below, describe steps 1-4 of a muscle contraction next to the corresponding number.



Station 2: Muscular Disease

Using the "Muscular Disease Charts" complete the following table. List ONLY 3 causes or risk factors, and treatment options for each disease.

| TABLE 2: Muscular Dystrophy | | | |
|-----------------------------|----------------------------------|------------------------|-------------------|
| Description | Cause or Risk Factors | Symptoms | Treatment Options |
| | | | |
| | | | |
| | | | |
| Tf mathan and fathan an | bonn connions for Nucho | no'a muqaulan what ia | |
| the chance they will have | e a child with MD2 | me's muscular, what is | |
| | Fibron | nyalgia | |
| Description | Cause or Risk Factors | Symptoms | Treatment Options |
| * | | | • |
| | | | |
| | | | |
| | | | |
| What is the most comm | n symptom for fibromyal | Sol | |
| | Mvasther | nia Gravis | |
| Description | Cause or Risk Factors | Symptoms | Treatment Options |
| | | | |
| | | | |
| | | | |
| | | | |
| What psychiatric disord | er is most commonly assoc | ciated with myasthenia | |
| gravis? | | | |
| Decerintian | Cerebro Causa an Disk Eastans | al Palsy Sumptome | Treatment Options |
| Description | Cause or RISK Factors | Symptoms | Treatment Options |
| | | | |
| | | | |
| | | | |
| How many children are e | stimated to cerebral pals | λ ; | |
| | Муо | sitis | |
| Description | Cause or Risk Factors | Symptoms | Treatment Options |
| | | | |
| | | | |
| | | | |
| What is the most commo | n type of myositis? | | |

Station 3: Muscle Contraction and Size

As a muscle contracts, multiple actin and myosin fibers throughout the muscle are being grabbed and pulled, causing the entire muscle to shorten. This creates firmness and sometimes the appearance of a bulge in the center of the muscle. In this activity, you will be investigating the relationship between a muscle contraction and the size of the muscle.



Procedure:

1. You will be working in pairs and will need a tape measure. Have your partner rest their forearm on a desk or table and relax the arm as much as possible. Wrap the tape measure around the upper portion of the arm and measure the circumference of the upper arm. Record your data in the table below in the Biceps/Triceps "Circumference Relaxed" box.

2. Have your partner put his/her hand under the table or desk with palm up and pull up hard against the desk/table to contract the biceps. Measure the circumference of the upper arm and record the data below.

3. Have your partner push the palms down hard on the desk/table to contract the triceps and measure the circumference. Record data below.

4. Have your partner relax their forearm and measure the circumference. Now make a fist to contract the forearm and measure the circumference of the forearm. Record data below.

5. While sitting, have your partner relax their leg as much as possible and measure the circumference of the upper leg. Record the data in the Quadriceps/Hamstrings "Circumference Relaxed" box.

6. Now have your partner flex the quadriceps as tightly as possible (the knee should be straight) and measure the circumference.

7. Have your partner stand and bend the knee to the "glutes" while contracting the hamstrings. Measure and record the circumference of the thigh.

8. Measure the circumference of the calf relaxed. Have your partner do a calf-raise (stand on the toes) and measure the circumference.



9. For each muscle in the table, subtract the circumference contracted from the circumference relaxed to determine the difference in size between the relaxed and contracted muscle.

Table 3: Muscle Contraction and Size

| Body Part | Circumference Relaxed (cm) | Circumference Contracted (cm) | Difference (cm) | List all muscles contracting in movement |
|------------|-------------------------------|----------------------------------|-----------------|--|
| Biceps | | | | |
| Triceps | | | | |
| Forearm | | | | |
| Quadriceps | | | | |
| Hamstring | | | | |
| Calf | | | | |

Summing Up Questions

1. What muscles would be used to:

| a. carry a tray | ? |
|-----------------|---|
| | |
| b. do a sit-up? | |

| c. kick a soccer ball? |
|------------------------|
|------------------------|

d. stand on your tiptoes? _____

2. What is the main function of the muscular system?

3. What are the 3 types of muscles and compare them to each other?

4. What attaches muscle to bone? _____

5. Which muscles are voluntary? Which are involuntary?

6. From the table in the background section (page 2), what muscular disorder was the most prevalent in 2009? Least prevalent?