**Discussion/Prelab**

* Review answers to previous lab
* Muscle fiber versus muscle cell (same thing) versus myofibril
* Encourage them to be familiar with the actions of the muscles as well as the locations
* Before signing off on the student labs, consider asking them to show you a particular muscle group or muscle action. They have to show or perform correctly before leaving.

**Muscles**

**Materials***:*

Microscopes

Slides:

Muscle slide: should have all three muscle types

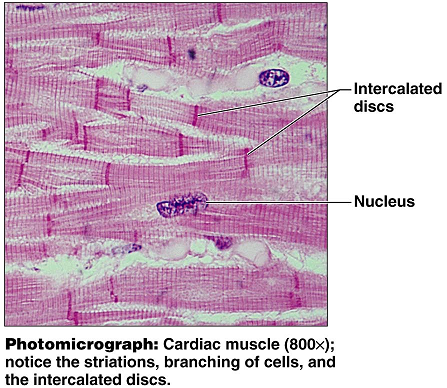
Clothes pin

Stop-watch, timer, or clock with a second hand

Recall that there muscle tissue is divided into three categories: skeletal, smooth, and cardiac. Review each of the three types of tissues under a microscope.

**Cardiac Muscle**

Cardiac muscle is found only in the heart. It is involuntary. The control for the cardiac muscles comes from within the heart: the SA node. The cardiac tissue is also striated. When viewed under a microscope, you should be able to observe the bands or striations. Notice the branching shape of the cells. They have a “Y” appearance to them. Also note the intercalated discs. These discs help form the gap junctions that allow for rapid communication within the heart tissue. View and draw cardiac muscle.

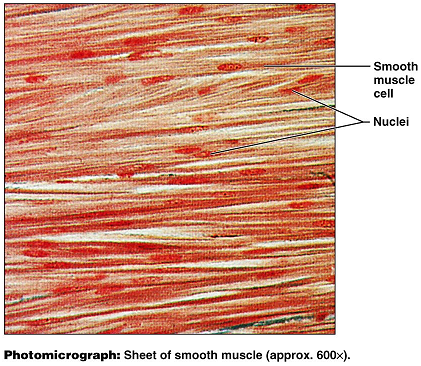




**Smooth muscle:**

Smooth muscle is located in organs and vessels. It is responsible for propelling food through the digestive tract as well as constricting blood vessels to raise blood pressure. The smooth muscle cell does not have striations, giving it a smooth appearance under the microscope. Smooth muscles have a tapered appearance, are shorter than skeletal muscle fibers, and have only one nucleus for each cell. View and draw smooth muscle.

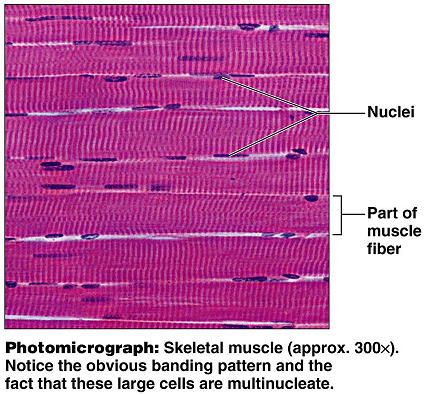




**Skeletal Muscle:**

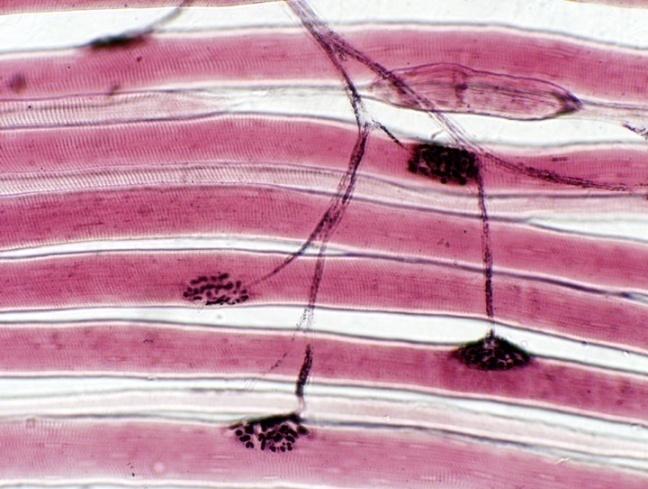
Skeletal muscle is voluntary and striated. Skeletal muscle cells (muscle fibers) are multinucleate. In addition to being able to see the banded appearance under high power, we can also observe the areas where it receives signals from nerves. View and draw skeletal muscle.

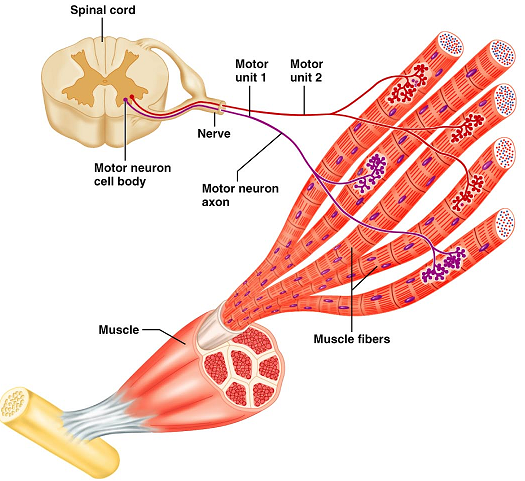


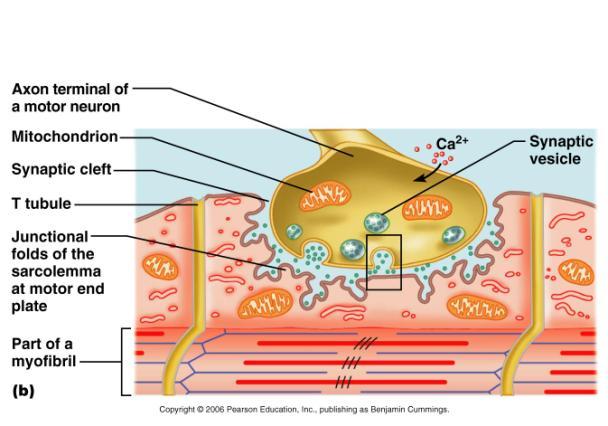


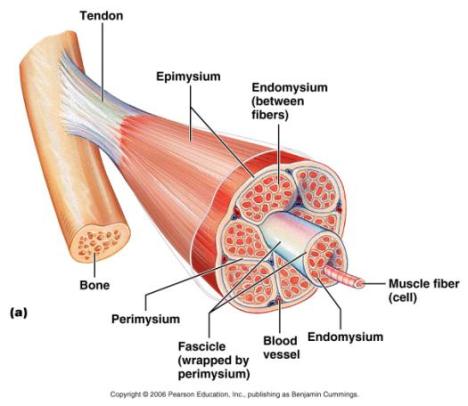
Motor Units:

A motor unit contains the nerve that runs to the muscle, and all of the muscle fibers that are innervated. Some motor units have one nerve fiber that runs to hundreds of muscle fibers. This type of arrangement gives us gross or bulky control. We see this type of arrangement in the low back muscles. Other motor units have one nerve fiber that innervates just a few muscle fibers. This is how we get our fine motor control. We see this in the eye muscles and in the fingers. View and draw a motor unit.









**Questions:**

1. In which type of tissue (cardiac, smooth, or skeletal) would neuromuscular junction be located?  
   Neuromuscular junctions are found when the somatic nerve fibers contact skeletal muscles at a region called the motor end plate.
2. What is the function of the gap junctions (intercalated disks) present in cardiac muscle tissue?  
   Gap junctions allow for rapid communication between cells
3. Which protein fibers in skeletal muscle act together to cause contractions?  
   The sliding movement of actin and myosin cause muscle contractions.
4. Describe the process that takes place at a neuromuscular junction. Try to put it into your own words.

Include the following terms: vesicle, neurotransmitter, synaptic cleft  
As the action potential reaches the end of the axon, the electrical charge causes calcium ions to be released. These calcium ions cause the vesicles that house the neurotransmitters to fuse with the axonal membrane, and the process of exocytosis empties the contents of the vesicles into the synaptic cleft. The acetylcholine (neurotransmitter) diffuses across the synapse until it comes in contact with a receptor located on the muscle. Once it binds, it causes the muscle to respond by releasing calcium and initiating the muscle contraction.

1. How does the shape and appearance of smooth muscle differ from skeletal muscle?  
   Skeletal muscles are lengthy cells that have a banded (striated) appearance and many nuclei per cell. A smooth muscle has a tapered appearance, on nucleus per cell, and no stria.

Skeleton muscle contracts rapidly. However, it also fatigues quickly as well. Compare this to smooth muscle and cardiac muscles that have a slower response, and little to no fatigue. To demonstrate rapid muscle contractions and fatigue, we’ll perform the following exercise.

1. Work in pairs. One person from your group will perform the exercise and the other person can record data and keep an eye on the time.
2. Get a clothes pin
3. To isolate the muscle activity, hold the clothespin with the thumb and index finger, but keep your remaining fingers straight (extended).
4. The timekeeper will announce the beginning of a 20 second interval.
5. The person with the clothespin with try to rapidly and repeatedly squeeze the clothespin open. Count the number of times you were able to open the clothespin within 20 seconds.
6. The timekeeper will note the end of the 20 seconds and IMMEDIATELY announce the beginning of another 20 second interval.
7. **Do not rest or relax between intervals**
8. Keep track of the number of pinches in each 20 second interval and record them below.
9. Record your results for a 3 minute span of time (complete nine 20-second rounds)

|  |  |
| --- | --- |
| Time (20 seconds each) | Pinches per round |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

**Answer the following questions:**

Did the skeletal muscles used show signs of fatigue? (yes)

What physical symptoms, other than your results, did you notice? (may feel pain/discomfort as the muscle fatigues and lactic acid builds up.)

What type of movement was being performed by the index finger? Flexion at the metacarpal-phalangeal joint.

Which muscles were causing that movement to take place? Flexor digitorum profundus and Flexor digitorum superficialis and the lumbricals (Chapter 10)

**Locating Muscles**

To “palpate” means to feel. Place your hand lightly over the muscle in question to feel the location and the contraction. Obtain your lab partner’s consent before palpating them. Be respectful of his or her space.

1. On your lab partner, palpate the **Deltoid** muscle. Activate it to view **arm abduction**.
2. On your partner, palpate the **biceps brachii** muscle. Activate it to view **forearm flexion**.
3. On your partner, palpate the **triceps brachii** muscle. Activate it to view **forearm extension**
4. On your partner, palpate **pectoralis major** muscle. Activate it to view **arm flexion**
5. On your partner, palpate **latissimus dorsi** muscle. Activate it to view **arm extension**
6. On your partner, identify the location of the **iliopsoas** muscle. Activate it to view **hip flexion**.
7. On your partner, palpate the **quadriceps** muscles. Activate them to view **knee extension**
8. On your partner, palpate the **hamstring** muscles. Activate them to view **knee flexion**.
9. On your partner, palpate **tibialis anterior** muscle. Activate it to view **dorsiflexion**.
10. On your partner, palpate the **gastrocnemius** and **soleus** muscles. Active them to view **plantar flexion**.

**Isotonic muscle contractions:**

As the tension on a muscle increases, the muscle will respond by changing length.

If you do a biceps curl holding a weight, you are performing an isotonic contraction. The biceps muscle changes length, and the forearm flexes at the elbow. Because the weight of your object remains the same, your muscle remains isotonic (same tone) even though the length of the muscle is changing.

**Concentric contractions**: A concentric contraction is a type of **isotonic** contraction. If you lift a 10 lb weight to do a biceps curl, you are performing a concentric contraction as you flex the forearm. The muscle is able to overcome the weight or resistance and shorten the muscle fibers.

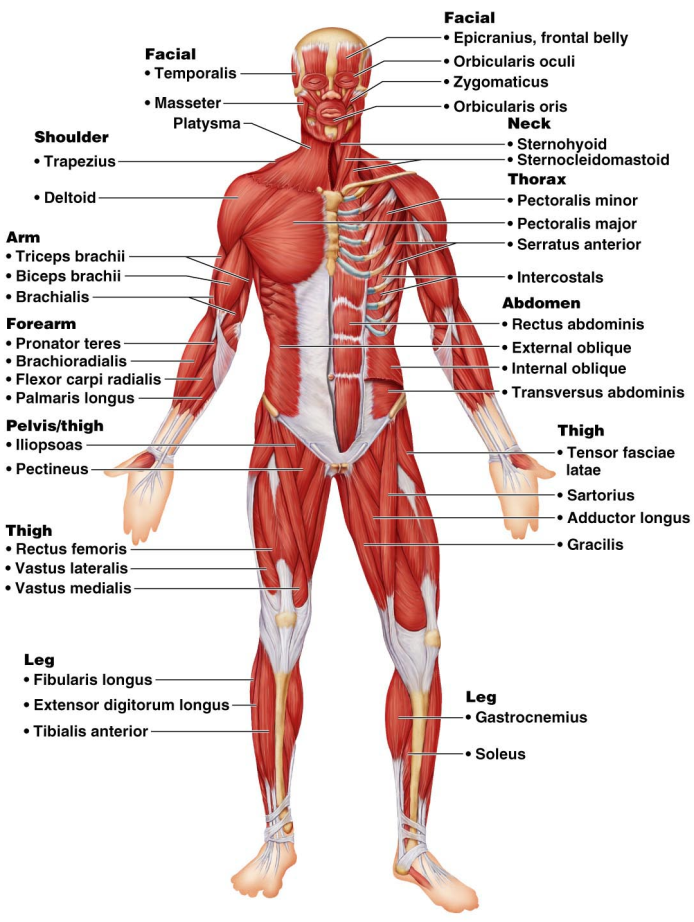
**Eccentric contractions:** An eccentric contraction is also a type of **isotonic** contraction. Eccentric contractions are often times described as “braking” contractions. With an eccentric contraction, the strength of the contraction is weaker than the amount of force being applied to it. Imagine that same bicep curl from above. As the forearm flexes, the biceps undergoes a concentric contraction, shortens, and brings the weight up. However, as the forearm extends, the triceps are activated. The triceps, plus the weight act to pull and lengthen the biceps muscle. The bicep is still contracting (braking) to slow or smooth the movement during the act of extension. If the eccentric contraction were absent, the forearm would flop into extension with no resistance and no control. An eccentric contraction is still an isotonic contraction because the length of the muscle is changing as the forces remain constant.

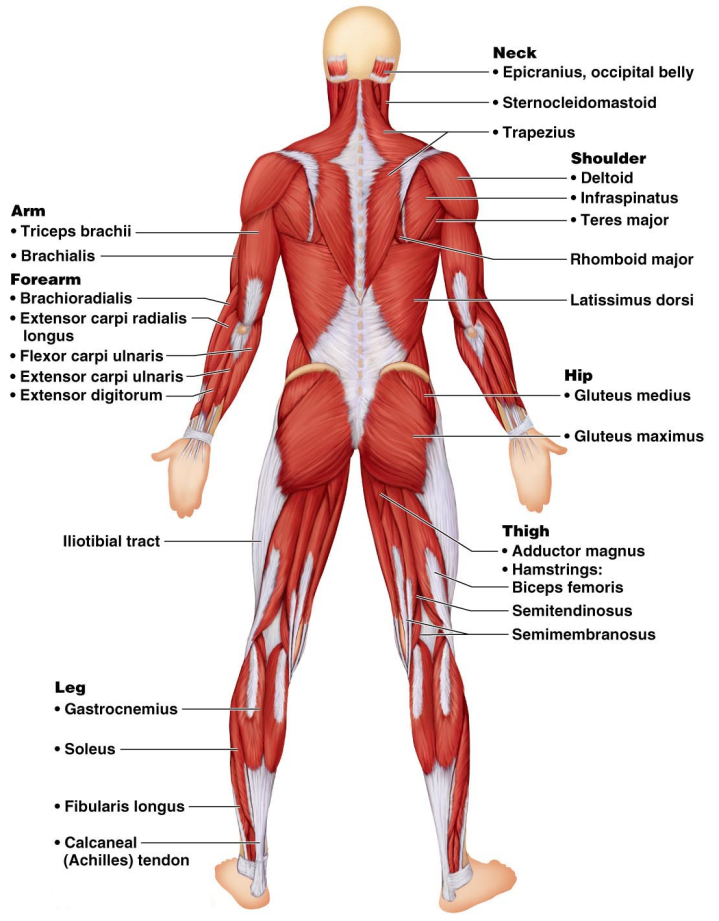
**Isometric contractions:**

With isometric contractions, the length of the muscle remains the same, but the forces exerted (tone) may change. As we attempt to move or lift object that exceed our muscles’ abilities, we utilize isometric contractions: trying to lift a car or pushing against a locked door. Our body uses isometric contractions in many of our postural muscles to allow us to maintain our balance.

**In the following questions, identify the muscle primarily responsible for the motion, the antagonist, and identify the type of contractions being used.**

1. In order to walk, we plantarflex at the ankle.
   1. Primary muscle used: **Gastrocnemius (and soleus)**
   2. Antagonist: **Tibialis Anterior**
   3. Contraction used in agonist (primary muscle): **concentric**
   4. Contraction used in the antagonist (opposing muscle): **eccentric**
2. Extension at the knee
   1. Primary muscle (group) used: **Quadriceps: Rectus femoris, Vastus lateralis, Vastus medialis, vastus intermedius**
   2. Antagonists: **Hamstrings: Semitendinosus, semimembranosus, biceps femoris**
   3. Contraction used in agonists: **concentric**
   4. Contraction used in antagonists: **eccentric**
3. Flexion at the hip:
   1. Primary muscles used: **Iliopsoas**
   2. Antagonists: **Gluteus maximus**
   3. Contraction used in agonists:  **concentric**
   4. Contraction used in antagonists: **eccentric**
4. Extension at the elbow (assume you are pushing against something that won’t budge)
   1. Primary muscle used: **triceps brachii**
   2. Antagonist: **biceps brachii**
   3. Contraction used in agonist: **isometric**





**Quiz Two: Lab Practical**

Covers **axial skeleton, appendicular skeleton, and muscles**

All information and images are potential quiz questions.

**Ask yourself…**

Do I know where each of the bones are?

Do I know the major features of each bone?

Can I identify an individual bone away from the skeleton?

Can I distinguish between the vertebrae (cervical/thoracic/lumbar) based on their shape?

Can I answer the bone questions from the lab manual?

Can I identify the structures on the images from the lab manual?

Do I know where the muscles are?

Can I distinguish between skeletal/smooth/cardiac on a microscope slide? Based on their descriptions?

Can I describe isotonic versus isometric contractions? Concentric versus eccentric?