

# The Skeleton and Muscle Systems

## OBJECTIVE:

In this lab you will identify the major bone and muscle systems of the human body. By understanding bone and muscle structures you will have a better appreciation of these systems.

## INTRODUCTION:

The skeletal system along with the muscular system, determines the shape of an organism, the support of other organs and the production of movement. In part one of this exercise you will study the bones of the human body. In the second part you will observe the muscle system of the human body.

## PART ONE

### The Human Skeletal System:

Bones are the main structural element of the skeletal system. Bones are held together by ligaments, which are made of dense connective tissue and are slightly elastic.

#### A. The Articulated Skeleton

The articulated skeleton is an assembled model of a human bone system. Examine the articulated skeleton in the lab. The human skeleton consists of the axial skeleton (skull, vertebrae, sternum, and ribs) and the appendicular skeleton (shoulder, arm, hip and legs). Identify the bones of these parts of the skeleton. Note the geometry of the skeleton,. Pay particular attention to the shapes of the bones, and the texture of them.

What did you find most interesting about the articulated skeleton? \_\_\_\_\_

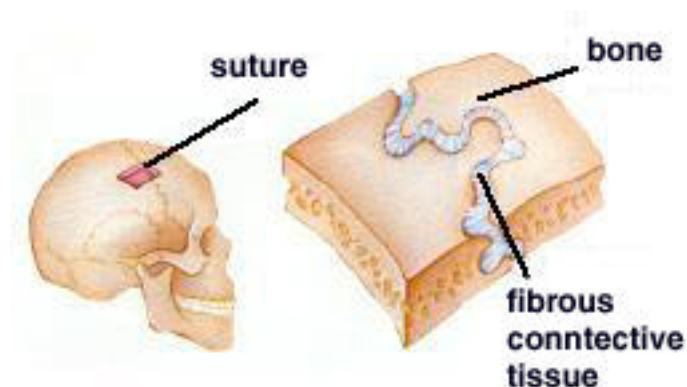
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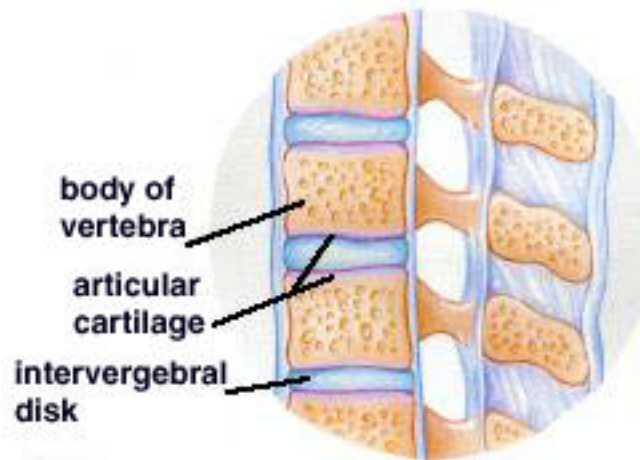
#### B. Bone Joints

Using the diagrams below study the planes in which the joints can move. There are three different types of joints that make up the human skeleton.

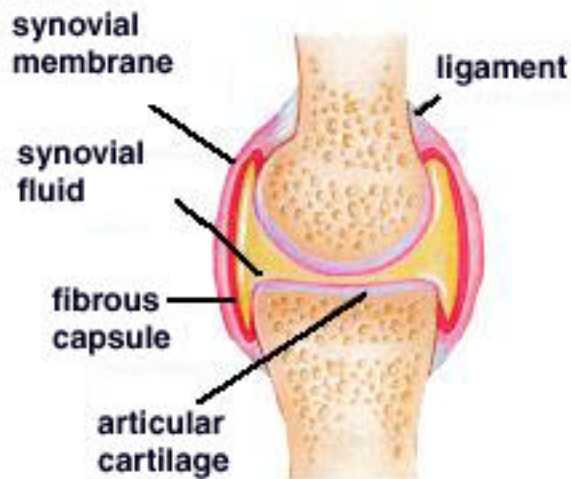
1. Suture joints are immovable joints that are held together by fibrous connective tissue. Observe suture joints in the skull.



2. Cartilaginous joints contain articular cartilage that cushions the two bones of the joint. These joints are found in our vertebral column.



3. Freely movable joints contain a synovial membrane that is filled with synovial fluid which provides lubrication.



Where would you find freely movable joints in your body? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**C.** Using the bone list below identify the bones on the skeletons which follow. This list will also help you to answer the questions which below.

### The Appendicular Skeleton

Shoulder

Clavicle - collarbone

Scapula - shoulder blade

Arm

- Humerus - upper arm
- Ulna - longer of the two bones of the forearm; is on the side of the little finger
- Radius - shorter of the two bones of the forearm; is on the side of the thumb
- Carpals - eight bones in the wrist bound by strong connective tissue
- Metacarpals - five main bones in the hand
- Phalanges - bones of the fingers

Leg

- Femur - thigh bone; above the knee
- Fibula - smaller, more slender of the two leg bones below the knee
- Tibia - shin bone; larger of the two leg bones below the knee
- Patella - knee cap
- Tarsals - seven bones of the ankle and heel
- Metatarsals - five long bones of the feet
- Phalanges - bones of the toes; two in the big toe and three in each of the other toes

Axial Skeleton

- Sternum - breastbone
- Ribs - normally 24 bones that make up the breast plate
- Vertebrae - 26 bones including the sacrum (forms part of the hip) and the coccyx (tailbone). The sacrum and coccyx are made of fused vertebrae
- Skull - 28 bones, including the inner-ear bones. Most bones of the skull are fused with immovable joints that appear as wavy lines

**Identifying the bones in your body.**

Clench your fist. What bones form the raised knobs of your knuckles \_\_\_\_\_  
\_\_\_\_\_

Flex your arm.  
a) What bones form the elbow? \_\_\_\_\_  
\_\_\_\_\_

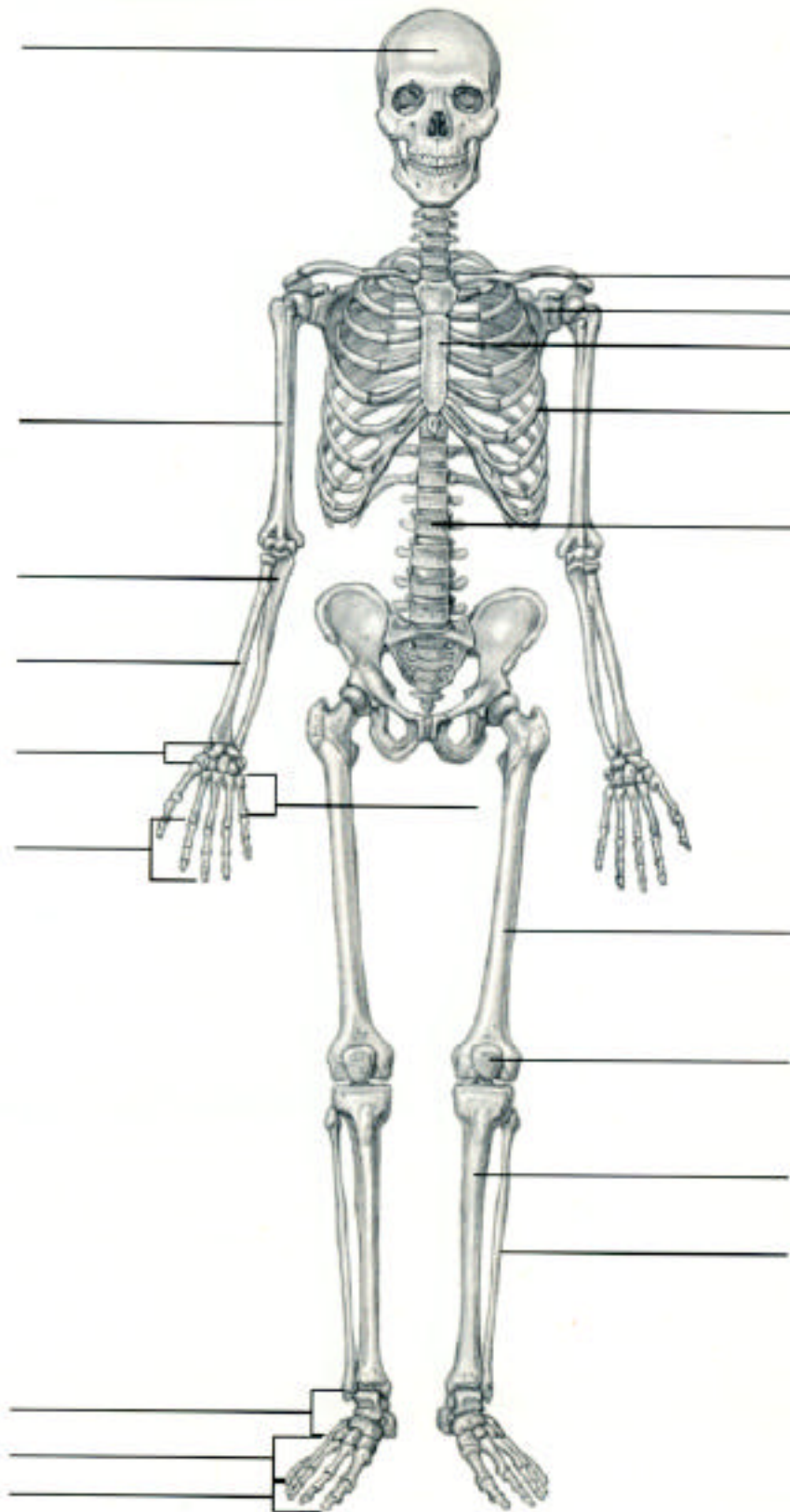
a) What is a "funny bone"? \_\_\_\_\_  
\_\_\_\_\_

Use your left hand to hold your right forearm near the elbow. Now rotate your right wrist from palm up to palm down. What bone is stationary? \_\_\_\_\_  
\_\_\_\_\_

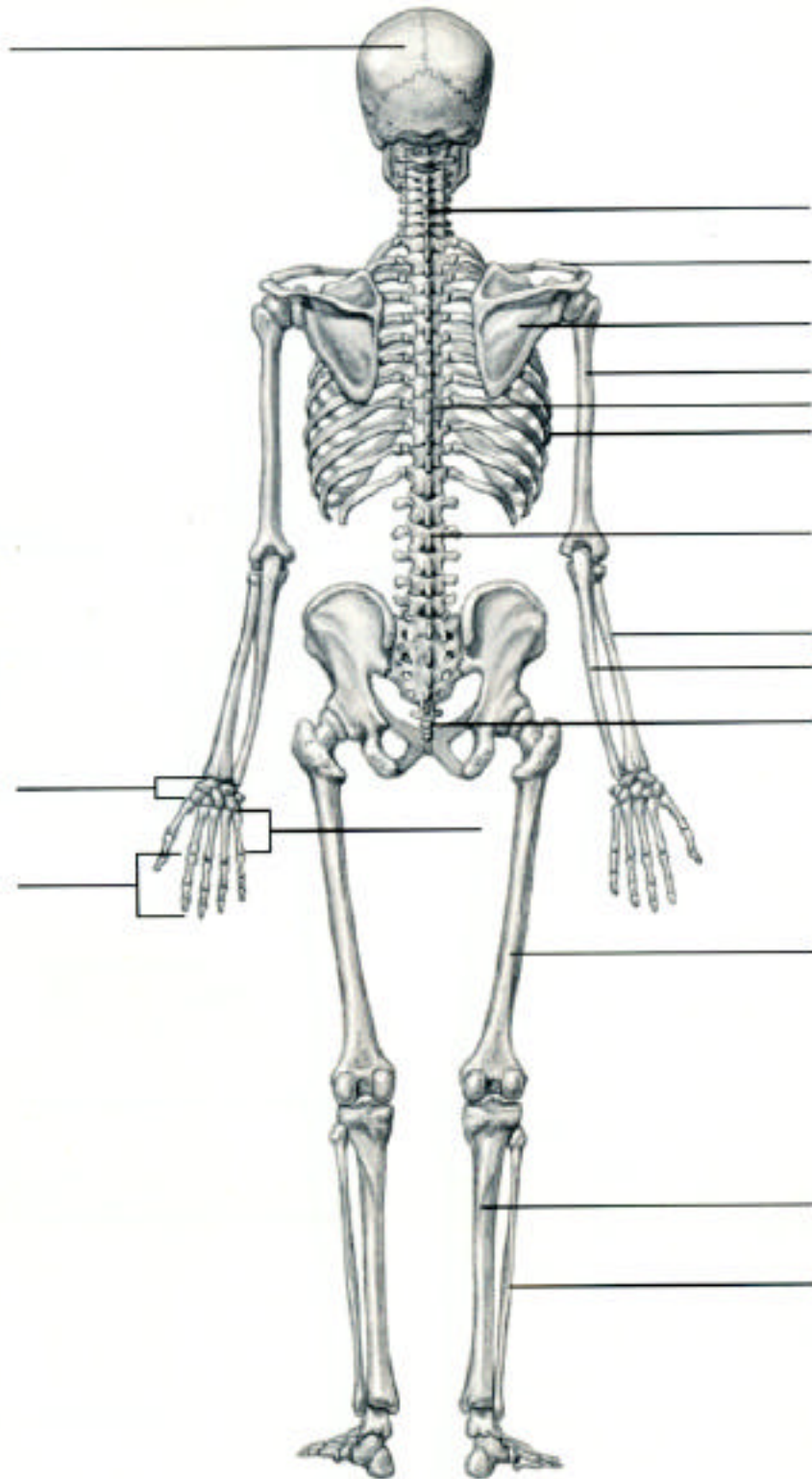
Bend your leg at the knee and feel your patella. Then feel the lump just below your patella. What bone forms that lump? \_\_\_\_\_  
\_\_\_\_\_

How many joints are in the skull? \_\_\_\_\_

Label the skeleton below



Label the skeleton below



## PART TWO

### Muscles and Muscle Contraction:

In part two of this lab you will study the major groups of skeletal muscles and how the major movable joints function. You will also study the mechanics and physiology of skeletal muscle contraction.

#### A. Muscle Structures

Muscles are structures specialized for contraction. Contrary to what many people think, muscles cannot actively lengthen; they can only contract (shorten). Some other force (e.g., gravity or the contraction of another muscle) is necessary to return the muscle to its original (uncontracted) length.

The force generated by a contracted muscle is called **muscle tension**. To move an object, the tension produced by a muscle must exceed the force exerted on the muscle by the object (i.e., the muscle's load). If this does not occur, the muscle cannot move the object.

There are two primary types of muscle contractions: isotonic and isometric. **Isotonic contractions** shorten the muscle, but the tension remains constant. You use this type of contraction when you lift weights. **Isometric contractions** increase the tension generated by the muscle without shortening the muscle. The power of contraction originates with the movement of contractile molecules in the fibers of muscle tissue. Study figure 1 to better understand the fine structure of a skeletal muscle.

What common activities involve isotonic contractions? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

What common activities involve isometric contractions? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

In both types of contractions, the amount of tension that is generated by the muscle is proportional to the number of muscle fibers that contract; the more fibers that contract, the greater the tension. Muscle tone is a sustained contraction of skeletal muscles that produces posture.

Why is muscle tone important? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Most joints are movable; they will move in one, two, or three planes, depending on the joint. Movement results from contraction of a skeletal muscle that connects a non moving bone (i.e., the origin) to moving bone (i.e., the insertion) across a joint.

In the next part of the exercise you will study how muscles flex or extend joints. The extension of a joint, such as when you straighten your arm, increases the angle between two bones. Flexing a joint, such as when you bend your arm, decreases the angle between two bones. More specifically the contraction of your biceps muscle flexes your arm, whereas the contraction of your triceps muscle extends your arm. In this example, as is true throughout most of your body, skeletal muscles are arranged in antagonistic pairs: when one contracts, the other relaxes.

## B. Major Groups of Muscles

Structure and function of muscles:

Extensor - muscle that straightens a joint

Flexor - muscle that bends a joint

Insertion - where muscle attaches at its more movable end

Origin - where a muscle attaches to a relatively fixed position

Shoulder and Trunk

Deltoid - inserts on humerus; originates on clavicle. When arm is at rest, the deltoid is outer muscle along the upper third of the humerus. When the arm is raised, the deltoid is the hard mass of muscle above the shoulder joint. The short, thick deltoid raises the arm to horizontal or slightly higher.

Pectorals - large, triangular muscle covering the upper part of the chest. Inserts on the humerus; originates from the clavicle, upper ribs, and sternum. If your arm is fixed, such as during climbing, the pectoral helps pull the chest upward. The pectorals are the "breast" of poultry and are the main flight muscles of birds.

Trapezius - inserts on the clavicle and along the scapula; originates along the upper dorsal midline. Aids in lifting with the arms or carrying loads on shoulders; braces and shrugs the shoulders.

Latissimus - large sheet of muscle in back. Inserts on the upper part of the humerus, and originates along the mid-dorsal line. Moves the arm downward. The latissimus is a primary muscle used in a swimming stroke or in bringing the arm forcibly downward.

Arm

Triceps - inserts on ulna and originates from scapula and humerus. The triceps extends the arm at the elbow and is the primary muscle for doing a push up.

Biceps - inserts on the radius; originates on the scapula. The biceps flexes the arm at the elbow and is the primary muscle for doing a pullup.

Wrist

Wrist flexors - muscles on the lower side of the lower arm which bend the hand at the wrist. With your palm up, you can see the tendons of the wrist flexors, especially if you are lifting something heavy.

Finger flexors and extensors - similar to those of the wrist. Identify these muscles and the long tendons that attach to them by clenching and extending your fingers. Note that the tendons are crossed from extensor muscles to the middle and ring fingers.

Skull

Masseter - the main muscle that clenches the jaw. You can feel this muscle at your temples and on either side of your cheekbone (zygomatic arch).

Legs

Hamstring - a set of three muscles on the back of the thigh that bend the leg at the knee. Originate on the ischial bone and femur; insert on the fibula. You can feel the hamstring's tendons at the back of your knee joint when you bend your knee while standing on the other leg. Hamstrings are so named because butchers use these tendons to hang up hams

Quadriceps - large muscle on the anterior part of the thigh that originates on the ischial bone and inserts on the tibia. The quadriceps extends the knee and enables you to stand from a squatting position. Also provides much of the power for kicking a ball.

Gastrocnemius - the calf muscle; originates on the femur and inserts (by the Achilles tendon) on the heel bone (one of the metatarsals). The gastrocnemius enables you to stand on tiptoe and extend your foot.

Toe flexors and extensors - several muscles in the lower leg that curl or extend the toes. Tendons from the extensors are visible atop your foot when you raise your toes

## Hip

Gluteus - large, powerful muscle in the posterior pelvic region. Inserts on the femur and originates from the coxal bone. The gluteus supports the pelvis and trunk on the femur (you can show this by standing on one leg and feeling the muscle). Used in climbing, cycling, jumping, and regaining an erect position after bending forward.

Abdominals - set of muscles below the chest that flatten and compress the abdomen. Abdominals bend the body forward and from side to side; also used to urinate and defecate.

## Identifying the muscles in your body.

### What muscles flex and extend the forearm?

- 1) Work in pairs for this exercise.
- 2) Feel the muscles of your partner's upper arm as it is extended and flexed.
- 3) Repeat this exercise as your partner holds a weight and then with his or her elbow pointed at the ceiling.

What muscle flexes at the forearm? \_\_\_\_\_

\_\_\_\_\_

What is at its origin? Its insertion? \_\_\_\_\_

\_\_\_\_\_

Which muscle extends the forearm? \_\_\_\_\_

\_\_\_\_\_

What is at its origin? Its insertion? \_\_\_\_\_

\_\_\_\_\_

### How does the structure of your hand effect its movement?

- 1) With your fingertips resting on the table, raise only your ring finger as high as it will go.
- 2) Now raise your middle finger as well.

Did your ring finger go higher? Why or why not? \_\_\_\_\_

\_\_\_\_\_

### What foot muscles flex and extend the lower leg and foot?

- 1) Feel the muscles of your thigh as you flex and extend the lower leg against an externally applied force.

What muscle extends the lower leg? \_\_\_\_\_

\_\_\_\_\_

What are its origins? Its insertions? \_\_\_\_\_

\_\_\_\_\_



What muscle flexes the lower leg? \_\_\_\_\_

\_\_\_\_\_

What are its origins? Its insertions? \_\_\_\_\_

\_\_\_\_\_

What muscle group extends the foot? \_\_\_\_\_

\_\_\_\_\_

What are its origins? Its insertions? \_\_\_\_\_

\_\_\_\_\_

What muscle group flexes the foot? \_\_\_\_\_

\_\_\_\_\_

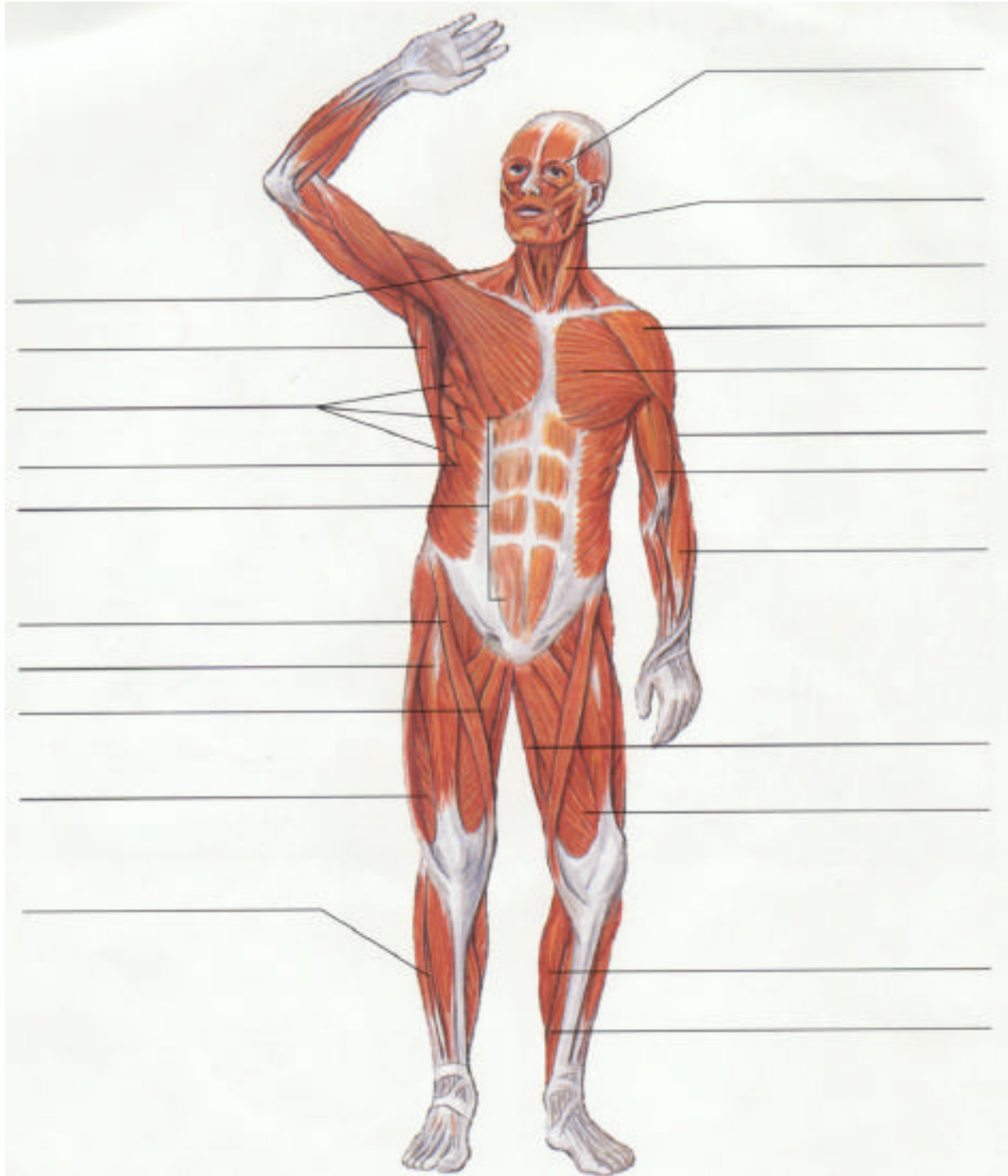
What are its origins? Its insertions? \_\_\_\_\_

\_\_\_\_\_

What common activities involve contraction of the gastrocnemius? \_\_\_\_\_

\_\_\_\_\_

Label the muscle structures below



Label the muscle structures below.



# Laboratory Questions

Student\_\_\_\_\_

Section\_\_\_\_\_

Date\_\_\_\_\_

- 1) How many bones are in your body?
- 2) What is the difference between a ligament and a tendon?
- 3) What is the longest bone in your body?
- 4) What bones form your ankle? Your neck? Your chest?
- 5) What causes a joint to move?
- 6) What would happen if both muscles of an antagonist pair contracted simultaneously?
- 7) What is a "pulled muscle"?
- 8) What other kinds of muscles besides skeletal muscles are there?

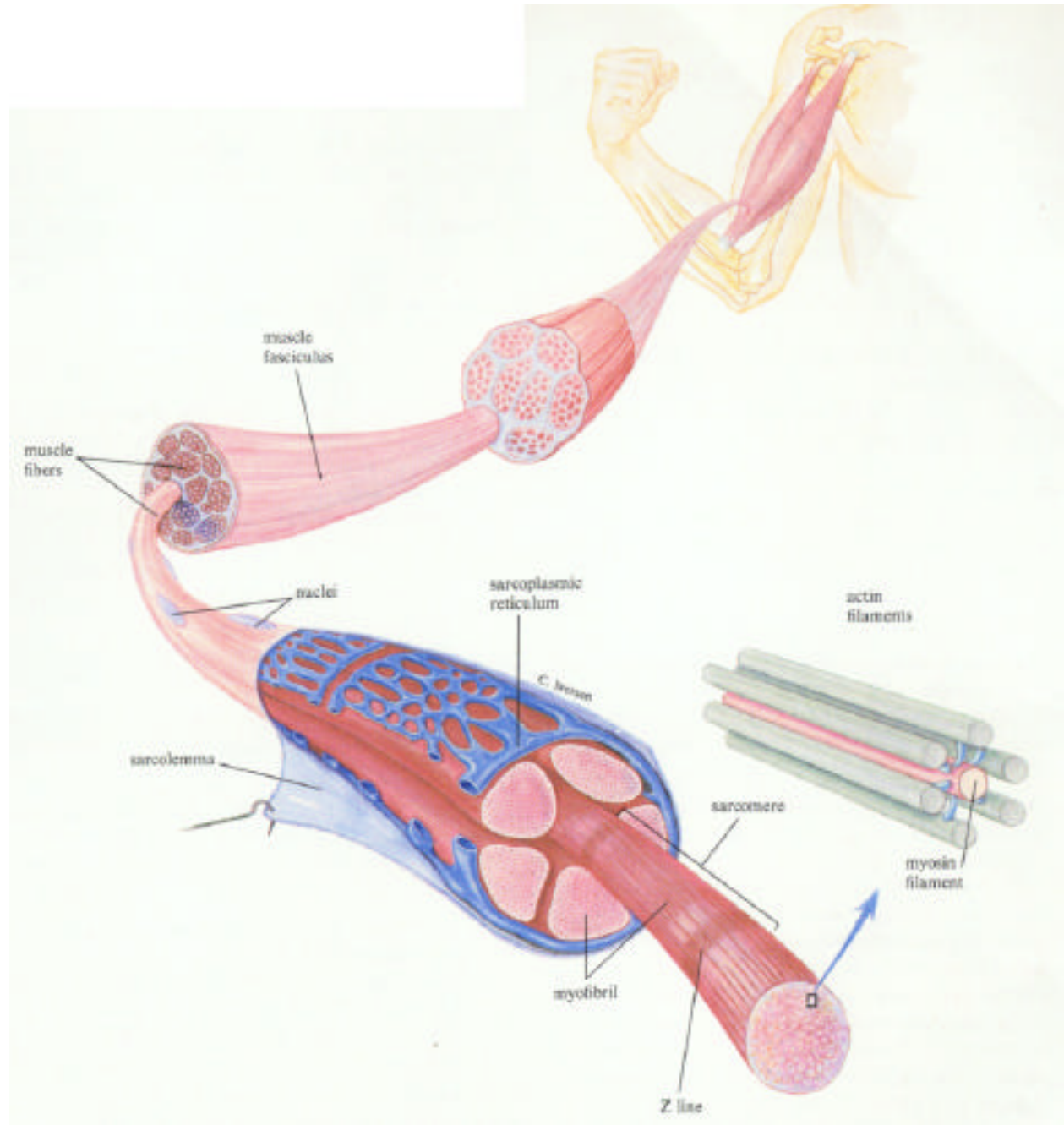


Figure 1