

Biology 13A Lab #6: Skeletal Muscles

Lab #6 Table of Contents:

• Expected Learning Outcomes	52
• Introduction	53
• Activity 1: Chicken Wings and Muscle Structure	54
• Activity 2: Muscles and Movement	58
• Activity 3: Learning Major Muscles & Their Actions	59

Expected Learning Outcomes

At the end of this lab, you will be able to

- compare bird and human forelimb structure and relate structure to function;
- identify skeletal muscle, fat, and connective tissues in a chicken wing;
- describe and demonstrate specific joint movements;
- locate and name major muscles of the body; and
- discuss the actions of major muscles during specific activities.



Figure 6.1 Andreas Vesalius woodcut, 1543

Introduction

Skeletal muscle is the most abundant tissue in the body of healthy adults, comprising anywhere from about 30 to 50% of total body mass. The amount of muscle mass varies due to age, sex, and physical activity. For example, adolescent males have a dramatic increase in the amount of muscle mass because of rising levels of testosterone which targets skeletal muscle cells and causes them to hypertrophy (grow). In contrast, both men and women lose muscle mass in old age, whereas relative proportions of body fat increase. At every stage of life, females have more body fat than males and correspondingly less muscle relative to body mass. Elite athletes have low levels of fat compared to lean body mass, most of which is muscle. The amount of muscle is important because it relates to more than just movement—it plays a role in homeostasis of blood sugar, body temperature and energy balance.

Movement occurs when muscle cells (fibers) shorten, or contract. At the molecular level, the motor proteins myosin and actin interact to pull the ends of cells closer together. A whole muscle such as the biceps brachii is comprised of millions of cells that work together to pull on connective tissue and

bone and produce movement at joints.

An entire muscle is covered with a saran wrap-like connective tissue sheath called the epimysium, or deep fascia. Within the muscle, bundles of cells (fascicles) are surrounded by thin layers of connective tissue (perimysium) that serve as pathways for nerves and blood vessels. Individual fibers are further packaged in layers of endomysium. The connective tissue permits penetration of tiny blood vessels that supply the energetically demanding cells. In addition, recent research suggests that mechanical forces transmitted through connective tissue interact with the sarcolemma (plasma membrane) and cause physiological changes in the cell, including stimulation of protein synthesis. The endomysium, perimysium, and epimysium converge to form thick, ropelike structures, the tendons, which connect the muscles to bones.

Check Your Understanding: Answer the following questions based on your reading of the introduction.

1. What proportion of body mass is skeletal muscle in healthy adults? What factors contribute to variation in muscle mass?
2. What motor proteins are responsible for movement?
3. Describe connective tissue layers associated with a whole muscle.

Activity 1: Chicken Wings and Muscle Structure

Chicken wings are **homologous** to the upper limb of humans; that is, they have many of the same structures due to their shared evolutionary history as vertebrates.

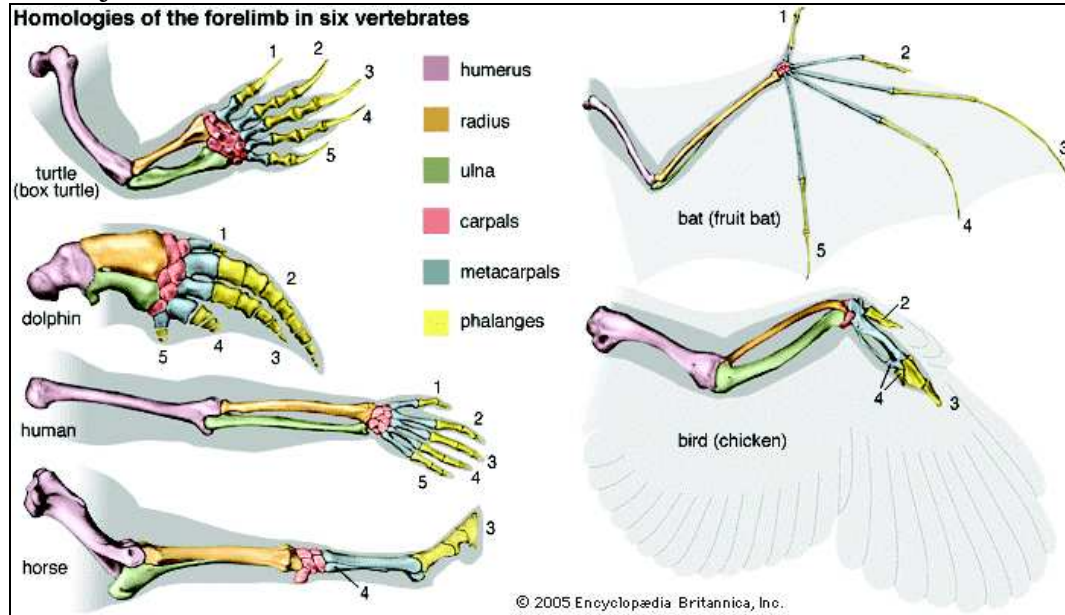


Figure 6.2 Homologous Forelimb Bones in Vertebrates

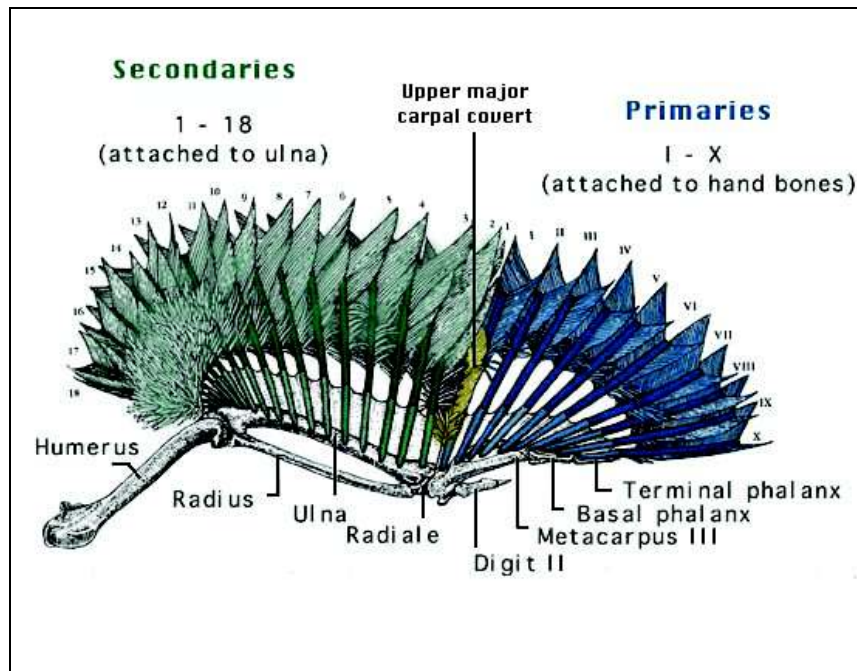


Figure 6.3 Chicken Wing

CAUTION: Raw chicken may be contaminated by Salmonella. Keep your hands away from your face and mouth throughout this investigation. Wash your hands and wipe the desks after the dissection.

1. Examine the chicken skeleton and human skeleton and identify the **humerus**, **ulna**, **radius**, and wrist (**carpal**), hand (**metacarpal**) and finger bones (**phalanges**) on each (see figs. 6.2 and 6.3).
2. Use scissors to cut the skin lengthwise to the joint between the upper wing and lower wing. Carefully peel the skin from the wing.

What skin layers did you cut through?

Examine the fat under the skin. What is the layer between the skin and muscle called? What is its function?

Which joint in your body corresponds to this joint in the chicken wing?

3. Remove the skin of the lower wing in the same way that you removed the skin from the upper wing. Leave the skin on the wing tip. Use scalpel and scissors to carefully remove the skin from the joint between the upper and lower wing. Be careful not to cut any tendons or ligaments. How will you recognize tendons and ligaments?

What is a tendon?_____

What is a ligament?_____

4. Observe the thin, transparent, shiny layer covering the muscles. This is the deep fascia, or **epimysium**, which surrounds an entire muscle and separates it from its neighbors. The epimysium consists mostly of strong collagenous fibers, which support the skeletal muscle tissue. This thin but strong packaging enables the muscles to carry out their specific intended action both in isolation and in concert with other muscles.
5. Carefully insert the tip of the scissors under the thin connective tissue and remove some of the connective tissue to expose the skeletal **muscle** tissue underneath.

6. Use a toothpick or dissecting needle to separate the muscles. Observe how the muscles are arranged in pairs on opposite sides of the bones.

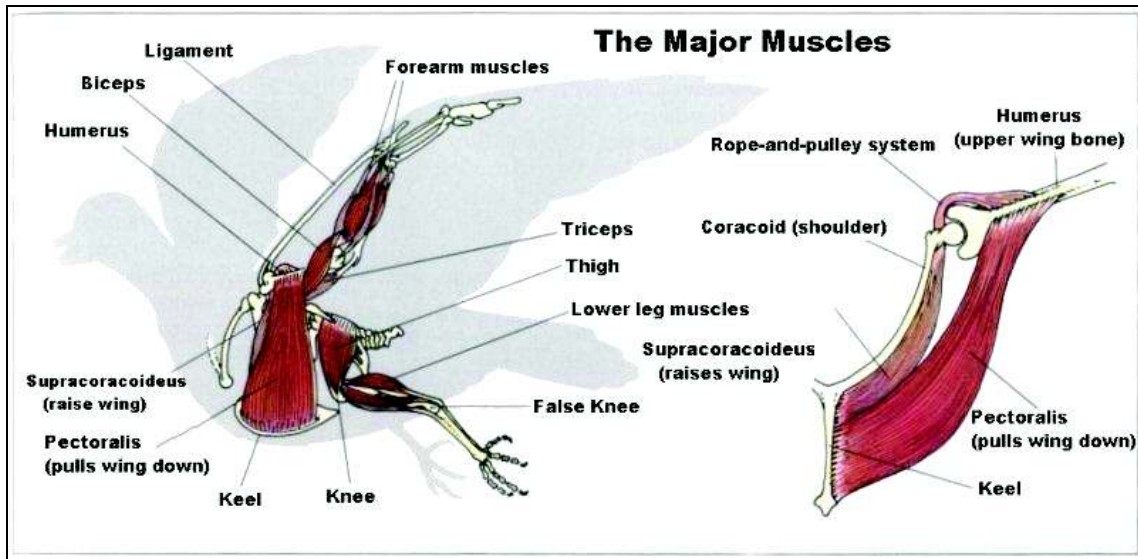


Figure 6.4 Bird Muscles

Locate the flexors and extensors of the elbow joint. These would be the anterior and posterior muscle groups attached to the humerus.

Name the primary elbow flexor. _____

Name the primary elbow extensor. _____

When muscles such as these act in opposition to one another, they are called _____.

Notice the attachment points of the muscles. The origin is nearer the chest, whereas the insertion is on the forearm bones, distal to the elbow joint.

7. Straighten the chicken wing and hold it horizontally above the tray. Pull on each of the muscles and note the movement that each muscle causes. Turn the wing upside down and bend the joints. Again pull on each muscle and note how the bones move.
8. Cut through the middle of a muscle that you have identified as a flexor for the upper wing. What happens to the wing?

Cut through the middle of a muscle that you have identified as an extensor for the lower wing. What happens to the wing?

9. Bend and straighten the joint and observe how the bones fit together. The shiny, white covering of the joint surfaces is made of cartilage. What is the purpose of this cartilage?
-

10. Identify several white tendons connecting muscle and bone in upper and lower wing muscle groups. Where these tendons run over joints--like the "elbow"--they are often in well-developed sheaths.

What tissue comprises tendons?

What is the source of the shiny, white color?

11. Locate blood vessels and nerves between muscle bundles and muscle bundles and bones. It is necessary to do some teasing with the dissecting probe to see these structures.

Clean Up!

12. Place the chicken wing and the protective gloves in a plastic bag for disposal and wash hands thoroughly with soap and water. Carefully clean work area with disinfectant spray.

Check Your Understanding: Answer the following questions based on your dissection of the chicken wing.

1. What structures of the chicken wing and human upper limb are homologous? Explain why they are homologous.
2. List five specific tissues that you examined in the chicken wing. Where are they located?
3. What is the role of blood vessels and nerves in skeletal muscle function?
4. What muscles flex and extend the elbow joint? What is the function of the action in chickens? In humans? Explain how differences in muscle and bone anatomy relate to the way of life of chickens (birds) and humans.

Sources: Bacon, C. Wings and Things. 2005. New Mexico State University GK12 Science Education. <nmsu.edu/gk12/Inquirybased%20Lessons/Wings%20and%20Things >
Ekstrom, J. The Wing and I. Access Excellence at the National Health Museum. <<http://www.accessexcellence.org>>