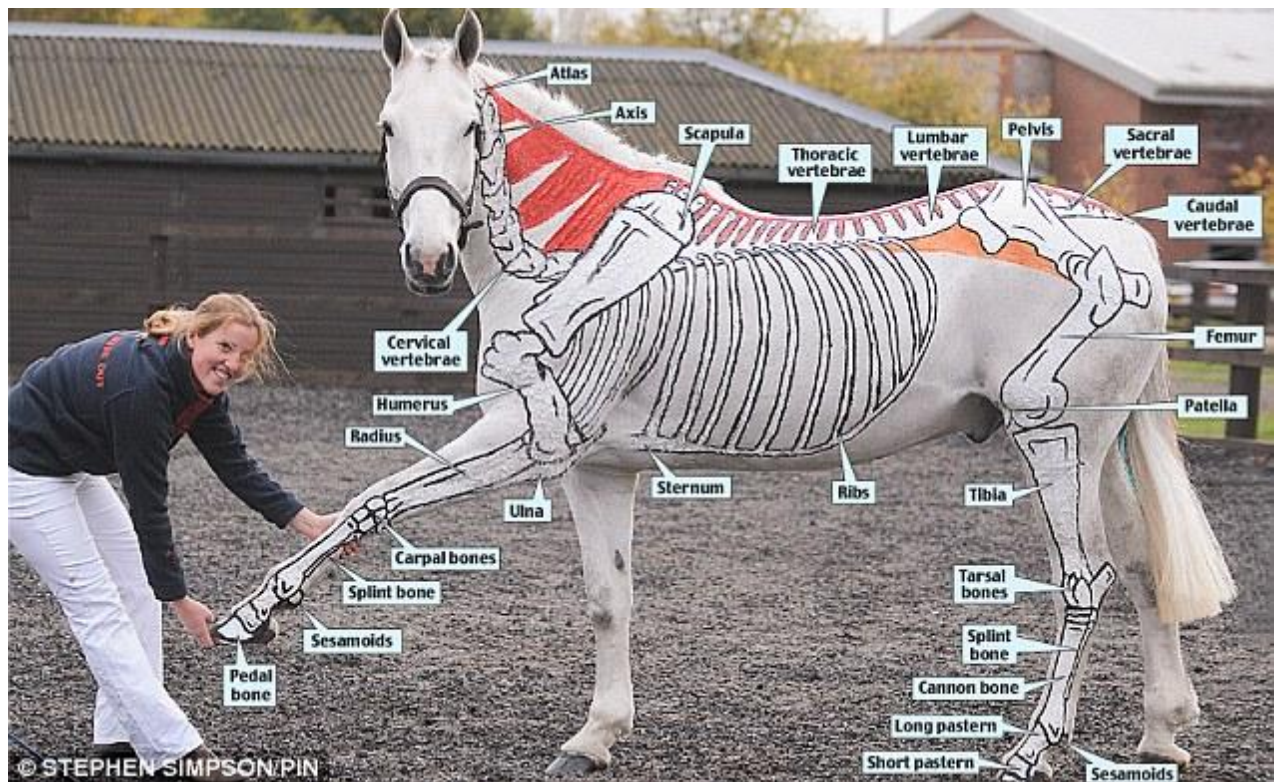


# Science of Veterinary Medicine



## Meat and Bones Unit Handouts



# ACTIVITY 3B: ANATOMY OF A BONE COLORING SHEET STUDENT PAGE

## ANATOMY OF A BONE

### Instructions:

Color the various structures of this long bone (humerus) in the following manner:

- 1) Use red for cancellous bone (e) and nutrient artery (h).
- 2) Any other colors may be used for the remainder of the picture.
- 3) The epiphysis (a) and diaphysis (b) are indicated with brackets to the right of the bone.

### EPIPHYSIS (end) (a), EPIPHYSEAL LINE (a)

The epiphysis is the end of a long bone. Externally, it has a thin layer of compact bone, while internally the bone is cancellous. The epiphysis is capped with articular cartilage.

### DIAPHYSIS (shaft) (b)

The diaphysis is the shaft of the long bone. It has compact bone with a central cavity. The diaphysis resists bending forces.

### ARTICULAR CARTILAGE (c)

The articular cartilage is found on the ends of long bones. It is smooth, slippery, and bloodless. It is kept moist by the egg-white-like fluid from the synovial lining of the joint cavity.

### PERIOSTEUM (d)

Periosteum is a fibrous, vascular, sensitive life support covering or sheath for bone. It provides nutrient-rich blood for bone cells and is a source of bone-developing cells during growth or after a fracture.

### CANCELLOUS (spongy) BONE (e) and MARROW (e)

The cancellous bone appears as tiny beams of bone arranged like a lattice. It resists the stresses of weight, changes in posture, and muscular development. Red marrow packs the spaces between beams of some epiphyses as well as elsewhere.

### COMPACT BONE (f)

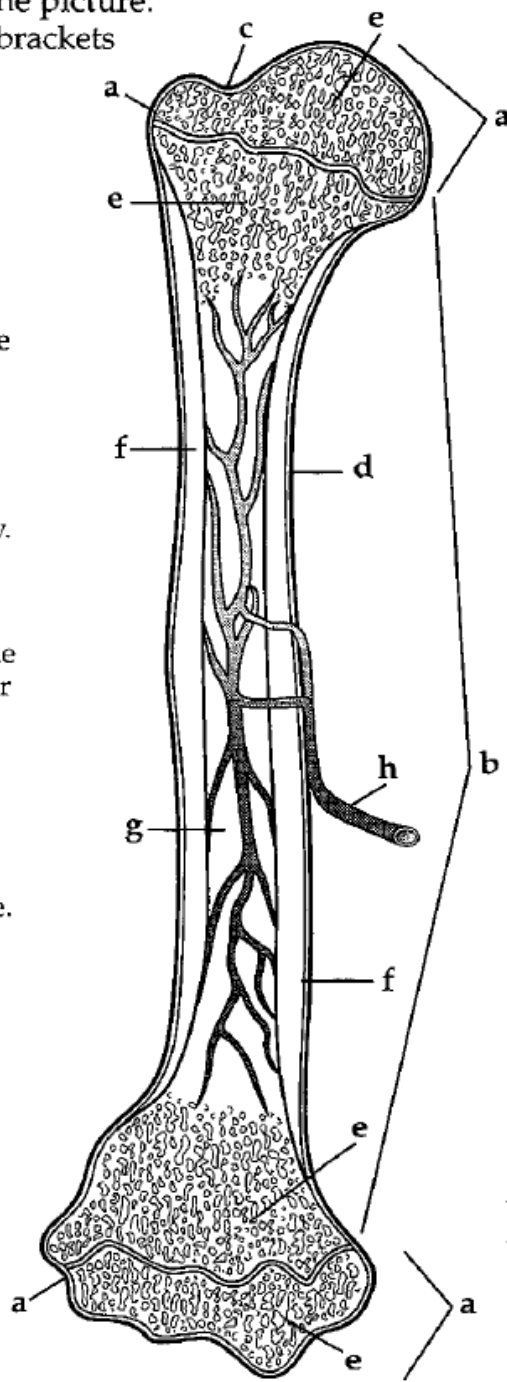
The compact bone is the dense bone found in the diaphysis. Its repeated pattern is arranged in concentric layers of solid bone tissue.

### MEDULLARY CAVITY (g), YELLOW MARROW (g)

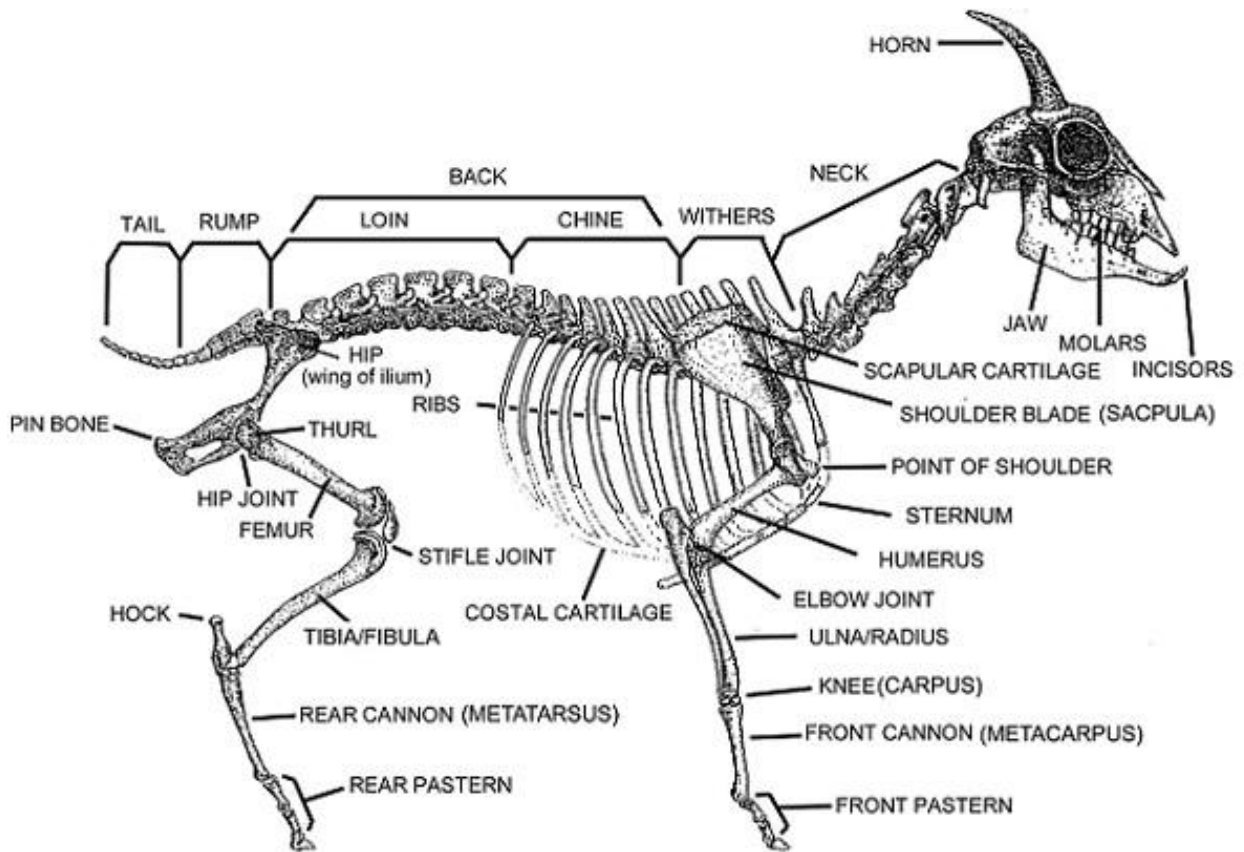
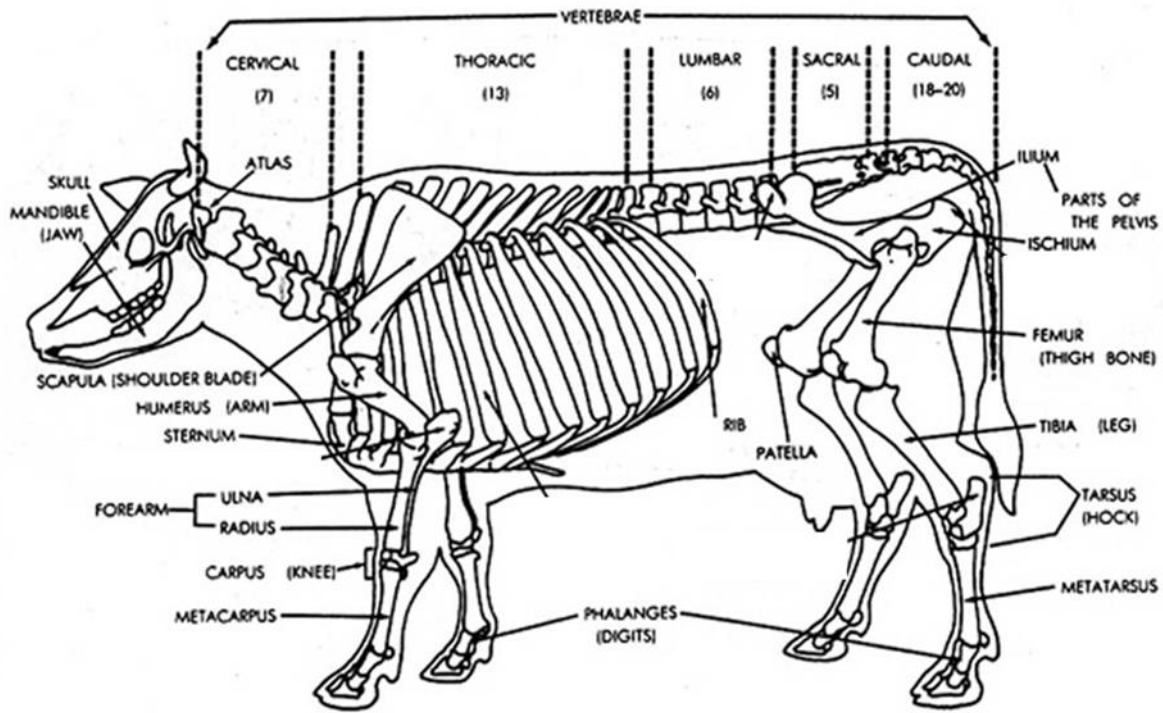
The medullary cavity of the diaphysis serves to lighten bone weight and provide space for its marrow.

### NUTRIENT ARTERY (h)

Each long bone contains an oblique tunnel in its shaft for the passage of a nutrient artery, which supplies the shaft.



12  
UNITS

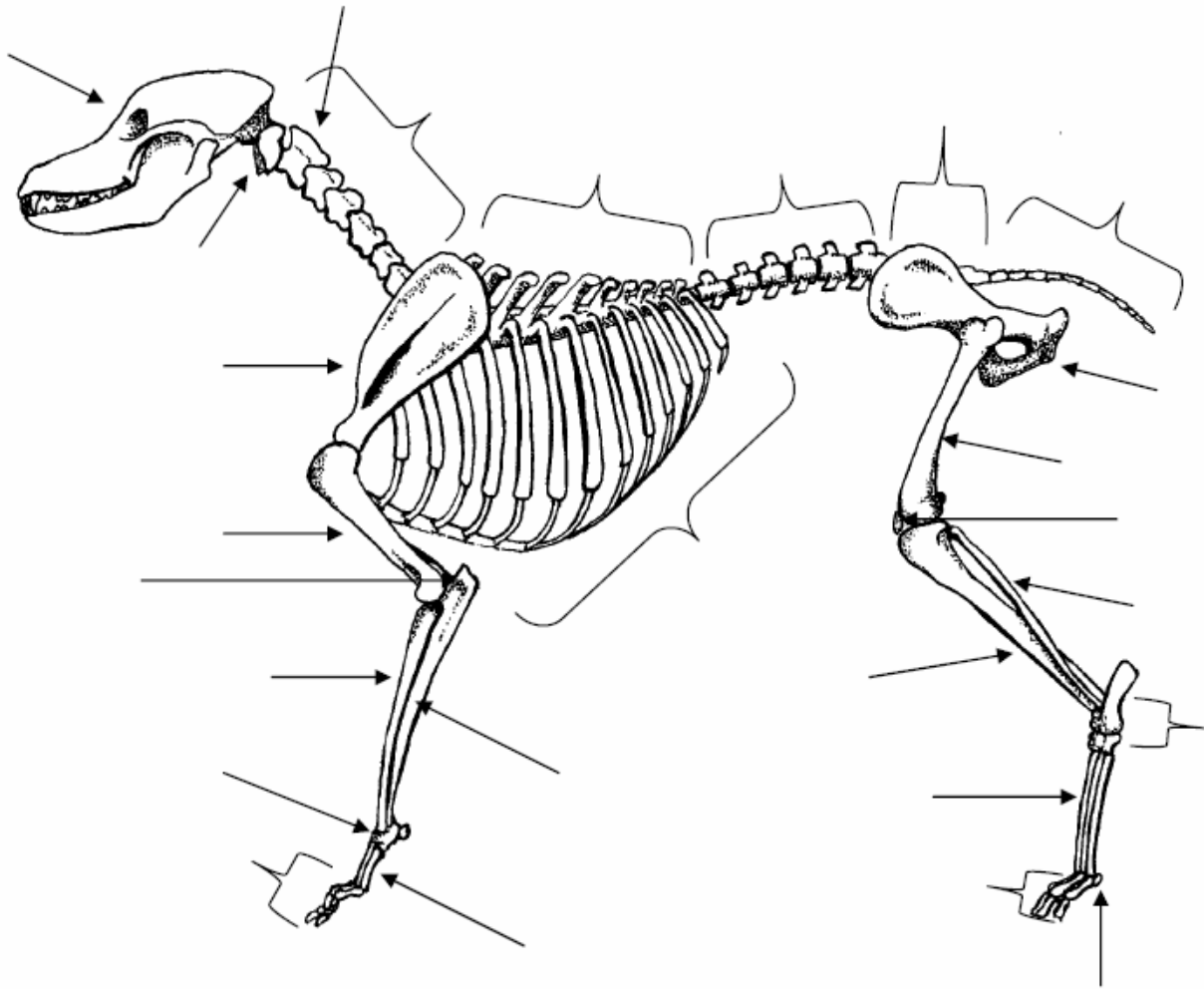


Name \_\_\_\_\_

## Skeletal Anatomy

**Directions:** Correctly label the bones on the drawing of the dog. Use a colored pencil to shade the bones of the axial skeleton.

|          |                     |                    |                  |
|----------|---------------------|--------------------|------------------|
| Skull    | Cervical vertebrae  | Thoracic vertebrae | Lumbar vertebrae |
| Ribs     | Sacral vertebrae    | Scapula            | Humerus          |
| Radius   | Coccygeal vertebrae | Carpus             | Phalanges        |
| Os coxae | Femur               | Tibia              | Patella          |
| Fibula   | Tarsus              | Metatarsals        | Metacarpals      |
| Atlas    | Axis                | Sesamoids          | Olecranon        |
| Ulna     |                     |                    |                  |

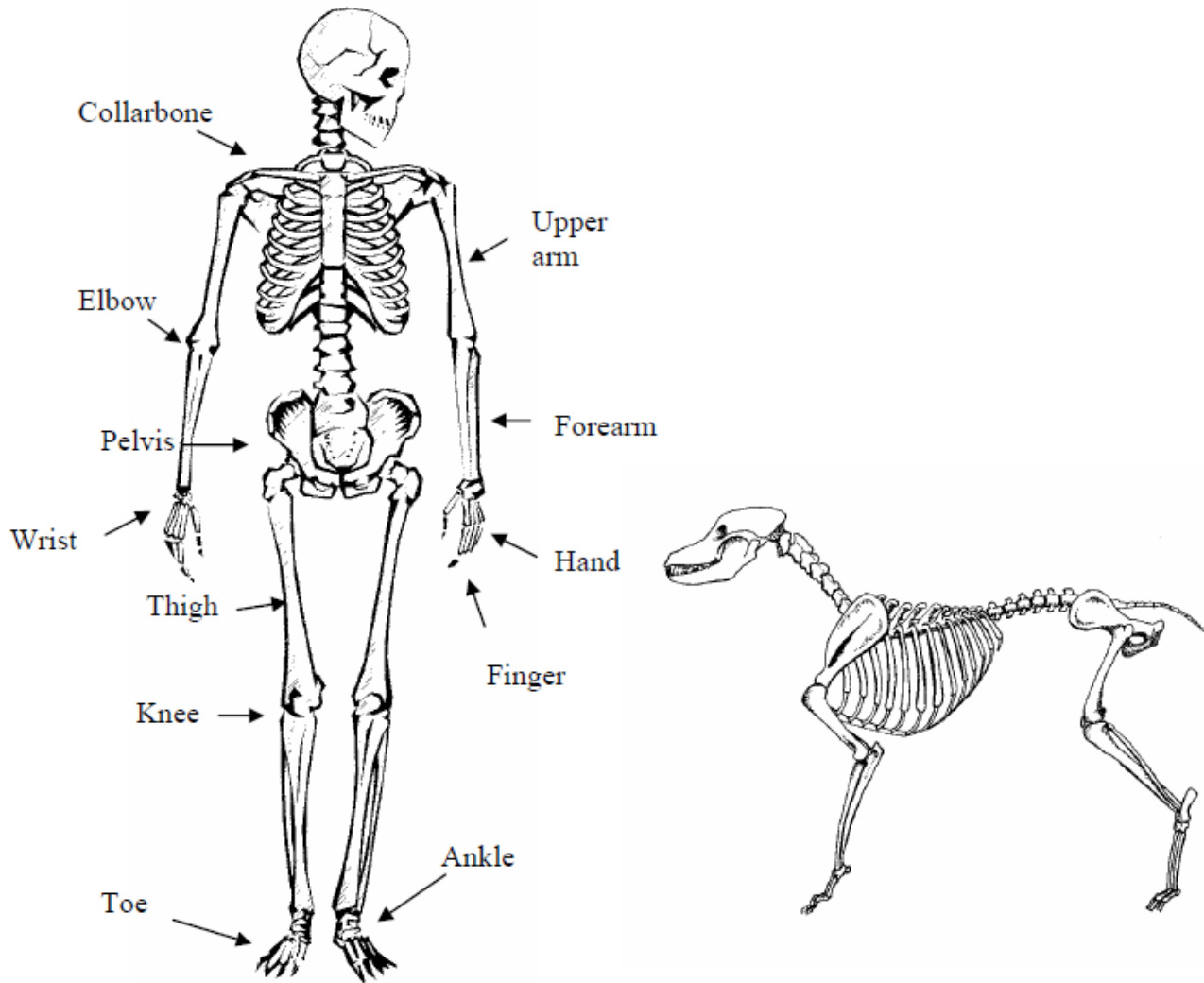




## Match the Dog to the Human!

**Directions:** In the spaces below, write the names of the bones of the dog that correspond to the bones of the human.

- |                 |                      |
|-----------------|----------------------|
| 1. Wrist _____  | 7. Elbow _____       |
| 2. Knee _____   | 8. Ankle _____       |
| 3. Hand _____   | 9. Upper arm _____   |
| 4. Toe _____    | 10. Forearm _____    |
| 5. Finger _____ | 11. Collarbone _____ |
| 6. Thigh _____  | 12. Pelvis _____     |



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

### **UGA discovery uses 'fracture putty' to repair broken bone in days**

Athens, Ga. - Broken bones in humans and animals are painful and often take months to heal. Studies conducted in part by University of Georgia Regenerative Bioscience Center researchers show promise to significantly shorten the healing time and revolutionize the course of fracture treatment.

"Complex fractures are a major cause of amputation of limbs for U.S. military men and women," said Steve Stice, a Georgia Research Alliance Eminent Scholar, animal and dairy scientist in the UGA College of Agricultural and Environmental Sciences and director of the UGA Regenerative Bioscience Center.

"For many young soldiers, their mental health becomes a real issue when they are confined to a bed for three to six months after an injury," he said. "This discovery may allow them to be up and moving as fast as days afterward."

Stice is working with Dr. John Peroni to develop a fast bone healing process. "This process addresses both human and veterinary orthopedic needs," said Peroni, an associate professor of large animal surgery in the UGA College of Veterinary Medicine and a member of the RBC.

Peroni and Stice are leading a large animal research project funded by the U.S. Department of Defense. The project includes scientists and surgeons from the Baylor College of Medicine, Rice University and the University of Texas, who conducted the early studies.

#### **Engineering new bone**

"Healing of critical-size defects is a major challenge to the orthopedic research community," Peroni said. "Large-bone defects must be stabilized and necessitate technologies that induce rapid bone formation in order to replace the missing tissue and allow the individual to return to rapid function. To date, no single material can suffice."

The group they lead is a multidiscipline and multi-institutional group actively working on bone tissue engineering.

"Our group has been working productively together on numerous projects through the last several years," Stice said, "So, a collegial relationship and successful collaborative working relationship is already established." Between 2009 and 2011, the collaborations received a \$1.4 million grant from the DOD for the use of stem cells in fracture healing to be tested in sheep. "In our experiences with large animal models, following the guidelines established by our animal care and use committee," Stice said, "we have been successful in formulating a product that contains mesenchymal stem cells and allows them to survive in the environment of the fracture long enough to elicit the rapid formation of new bone."

This year, the group showed bone can be generated in sheep in less than four weeks. The speed in which bone is formed is one of the truly unique features of this study.

#### **Fracture putty**

To start the bone regeneration process, the RBC used adult stem cells that produce a protein involved in bone healing and generation. They then incorporated them into a gel, combining the healing properties into something Stice calls "fracture putty."

With Peroni's assistance, the Houston-based team used a stabilizing device and inserted putty into fractures in rats. Video of the healed animals at two weeks shows the rats running around and standing on their hind legs with no evidence of injury. The RBC researchers are testing the material in pigs and sheep, too.

"The small-animal work has progressed, and we are making good progress in large animals," he said.

More work is needed to get to human medical trials, but the threat of losing federal funding for biomedical work through the DOD means they will have to find new ways to fund the project.

**Next steps**

"The next step is to show that we can rapidly and consistently heal fractures in a large animal," Peroni said, "then to convert it to clinical cases in the UGA [College of Veterinary Medicine] clinics where clinicians treat animals with complex fractures all the time."

Once they have something that works for animals, it will be passed over to the DOD for human use.

Peroni, who is chairman of the North American Veterinary Regenerative Medicine Association, is hopeful this material will be promoted to the veterinary and human medical fields through the educational efforts of NAVRMA and the RBC.

However, the RBC isn't the only group working on a faster fix for broken bones.

"Our approach is biological with the putty," Stice said. "Other groups are looking at polymers and engineering approaches like implants and replacements which may eventually be combined with our approach. We are looking at other applications, too, using this gel, or putty, to improve spinal fusion outcomes."

**Analysis:**

Describe the importance of this discovery. What are its current benefits? What are some possible uses in the future.?

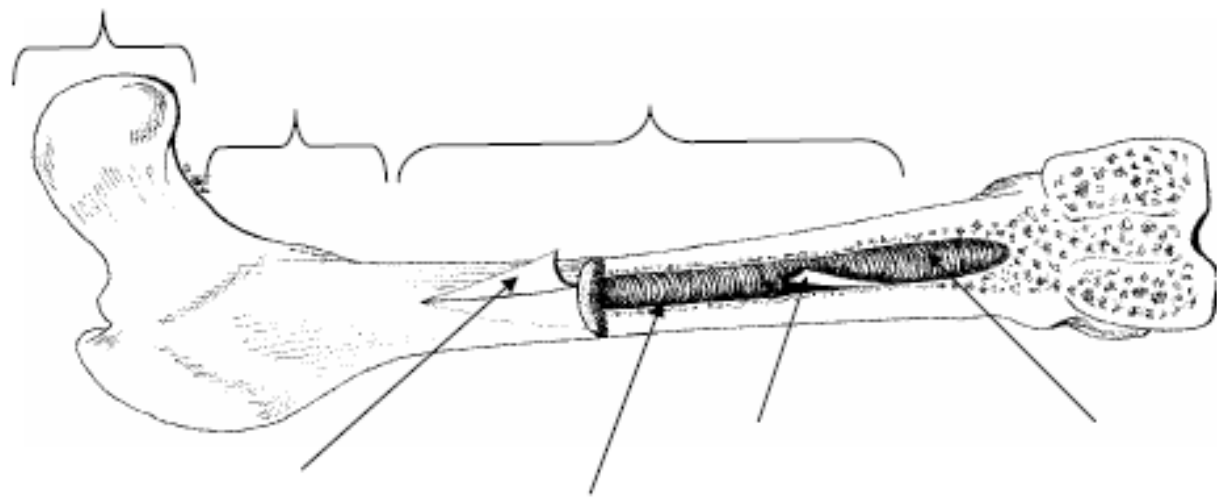


Name \_\_\_\_\_

## Bone Anatomy & Types of Fractures

Directions: Label the parts of the bone.

- Epiphysis
- Metaphysis
- Medullary cavity
- Bone marrow
- Diaphysis
- Endosteum
- Periosteum



### Types of Bone Fractures



Fissured



Greenstick



Transverse



Comminuted

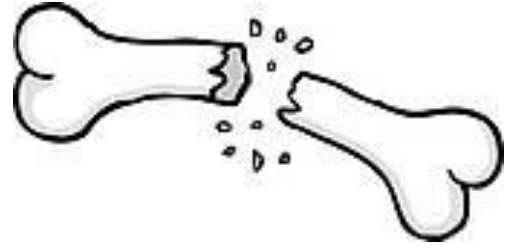
Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

## Bone Trauma

**Essential Question:** How can you repair a broken bone?

### Materials:

- Chicken bone (Cleaned)
- Hammer
- Safety Goggles
- Materials to repair bone (You will determine these materials)



### Part 1: Bone Anatomy

- Obtain a chicken bone. Examine the bone.
- Sketch the bone, labeling the major parts (from your notes)

### Part 2: Bone Fractures

- Wearing goggles, gently hit your bone with a hammer causing a break (Remember: the more force, the more complicated the break)
- Sketch the broken bone and identify the type of fracture:

Fracture Type: \_\_\_\_\_

## **REPAIRING BROKEN BONES**

### **Part 3: Brainstorming Design Ideas**

In the space below, brainstorm several different ideas your group has for how you can repair the broken bone you have received.

**Part 4: Design Alternatives**

Based on your brainstorming, sketch two designs of different ways you might be able to repair your bone. Please label the parts and materials that you will use in each design.

| Design 1 | Design 2 |
|----------|----------|
|          |          |

**Part 5: Evaluate Design Alternatives**

|  | Design 1 | Design 2 |
|--|----------|----------|
| How will each design support the weight and movement of the patient?   |          |          |
| Is it minimally invasive (easy for doctor to implant)? Why or why not? |          |          |
| Are the materials biocompatible? Explain                               |          |          |
| Is it realistic? Explain   |          |          |
| What are the strong points and weaknesses of the design?               |          |          |



## Bones

**Bone** is a dynamic, living tissue — not the hard, dry, lifeless frame seen in scary movies or desert scenes or even on a pirate flag. About 30% of bone is living tissue, cells, and blood vessels — the tissues that make your bones grow. The blood vessels go in and out of the bone carrying oxygen and nutrients, and taking away wastes. Bones contain marrow which produces red blood cells and white blood cells. Bones have nerves that can feel pressure and pain. Bones even help us hear! About 45% of bone is mineral (primarily calcium and phosphorus), giving bone its hardness and rigidity and storing these minerals for future use. Bone releases some of this mineral when other body parts, such as nerves, may need them. Bone also contains the proteins, collagen and elastin. Finally, about 25% of bone is made up of water.

Bone tissue consists of **compact** bone (cortical or solid bone) and **spongy** bone (trabecular or cancellous bone). Compact bone is made up of structural units called **Haversian** systems. The system is composed of concentrically arranged layers of hard inorganic matrix surrounding a microscopic central Haversian canal. Blood vessels and nerves pass through the canal. Spongy bone is like a network of hardened bars with spaces between them filled with marrow.

Bone tissue is made and maintained by several types of cells: **osteoblasts**, **osteocytes**, and **osteoclasts**. Osteoblasts make new bone by hardening the protein, collagen, with minerals. Osteocytes maintain bone, passing nutrients and wastes back and forth between the blood and bone tissues. Osteoclasts destroy bone, releasing minerals into the blood. All through life, bone is continually being reconstructed and reshaped.

A baby has very soft bones made up of cartilage. As the infant grows, the cartilage is replaced by calcium (ossification). When a person reaches the age of 20 or so, the bones stop getting longer or bigger, but there is still a lot of growing going on. Old bone cells dissolve and are replaced by new bone cells. Because bone keeps growing, your body is able to repair any breaks that may occur.

Bone is made up of a hard outer “shell” consisting of compact bone. Tendons, ligaments, and other parts attach to this shell by way of the bone’s covering, the **periosteum**. Inside the compact bone is a looser network of spongy bone containing **marrow**. There are 206 bones in the human body, making up our skeletal systems. Over half of them are in the wrists, ankles, hands, and feet! The skeletal system provides a strong framework for the body giving our body its shape, and permits us to stand upright. It supports and protects vital internal organs such as the brain and heart. It provides a point of attachment for muscles and connective tissue (ligaments, tendons, cartilage) and certain bones, connected at flexible joints, form a combination of levers that allow coordinated movement.

Bones may be classified into four groups: long bones, flat bones, short bones, or irregular bones. (These groups are discussed in Activity 2F.) Long bones are strong shafts made of compact bone tissue with the ends consisting of spongy tissue covered with compact tissue. Their slightly curved shafts enable them to absorb shock. Flat bones provide broad surfaces to protect other structures and for anchoring muscles. They are broad flat plates of spongy tissue sandwiched between two layers of compact tissue. Short bones are strong, irregular cubes, made of spongy bone covered with compact tissue. Irregular bones are shaped differently enough that they cannot be grouped with the other three types of bones. Their proportion of spongy to compact tissue varies from bone to bone.

### HEALTHY BONE REMODELING

Healthy bone remodeling occurs at many simultaneous sites throughout the body where bone is experiencing growth, mechanical stress, microfractures, or breaks. About 20% of all bone tissue is replaced annually by the remodeling process. There are five phases in the bone remodeling process: **ACTIVATION**, **RESORPTION**, **REVERSAL**, **FORMATION**, and **QUIESCENCE**. The total process takes about 4 to 8 months, and occurs continually throughout our lives.

You will create your own **The Osteo Blaster/Cluster Wheel**. The numbers on the wheel match those of the chart on the next page, as well as, the questions on **The Osteo Blaster/Cluster Worksheet**. The cover for the wheel needs to be carefully cut out along the dark lines. Line up the center of the cover with the base and secure it with a brad.

The information on the chart describes some of the events that occur during *normal* bone remodeling, maintenance, and repair. Use this information to describe the events that you see on the wheel. After the information for all eleven sections is explored, complete **The Osteo Blaster/Cluster Worksheet**.

**Normal Bone Remodeling-Normal Maintenance and Repair "Ordered Coupling"**  
*Osteoblasts and Osteoclasts, "blast/clast," activity is in balance*

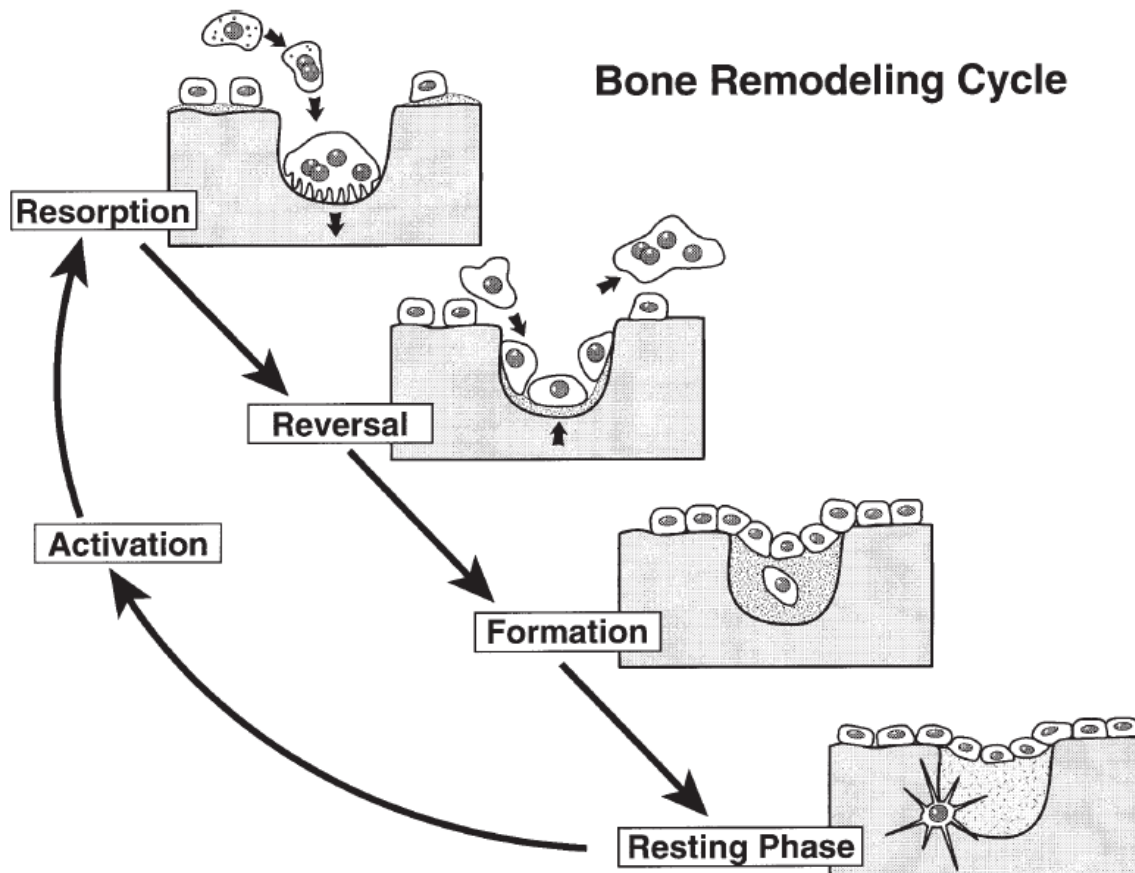
| - PHASE -         | - PHASE EVENTS -   |
|-------------------|--|
| <b>ACTIVATION</b> | 1. Pre-osteoclasts are attracted to the remodeling sites.<br>2. Pre-osteoclasts fuse to form multinucleated osteoclasts.   |
| <b>RESORPTION</b> | 3. Osteoclasts dig out a cavity, called a resorption pit, in spongy bone or burrow a tunnel in compact bone.<br>4. Calcium can be released into the blood for use in various body functions.<br>5. Osteoclasts disappear.                    |
| <b>REVERSAL</b>   | 6. Mesenchymal stem cells, <i>pre-cursors</i> to osteoblasts, appear along the burrow or pit where they...<br>7. <i>proliferate</i> (increase in numbers) and <i>differentiate</i> (change) into pre-osteoblasts, then ...                   |
| <b>FORMATION</b>  | 8. <i>mature</i> into osteoblasts at the surface of the burrow or pit and ...<br>9. release <i>osteoid</i> at the site, forming a new soft nonmineralized <i>matrix</i> .<br>10. The new matrix is mineralized with calcium and phosphorous. |
| <b>QUIESCENCE</b> | 11. Site, with resting lining cells, remains <i>dormant</i> until the next cycle.  |

Normal bone is always undergoing remodeling. This remodeling removes old bone tissue and replaces it with new bone tissue. The remodeling cycle, removing and building tissue, continues throughout life and is typically "in balance" to maintain healthy bone.

This remodeling cycle involves bone "resorption" by the osteoclasts. The osteoclasts remove the old stressed or worn-out mineralized bone. This recreates a "resorption pit."

The "resorption" process causes osteoblasts to become attracted to the "resorption pit." Osteoblasts rebuild new bone tissue by laying down an unmineralized matrix, called osteoid, which will eventually form new mineralized bone.

When this rebuilding is complete, the area of bone remodeling rests until the next remodeling cycle begins.

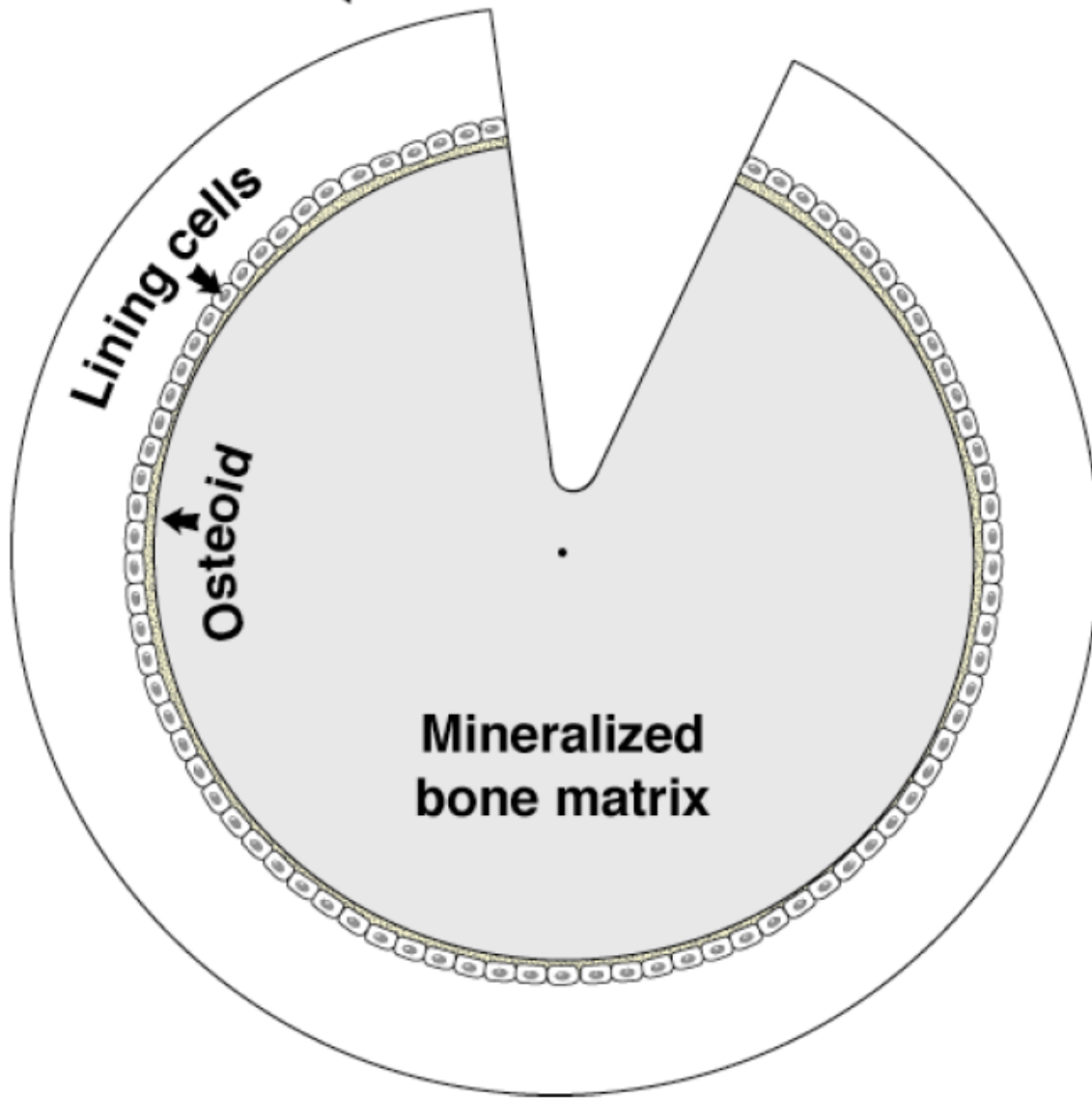
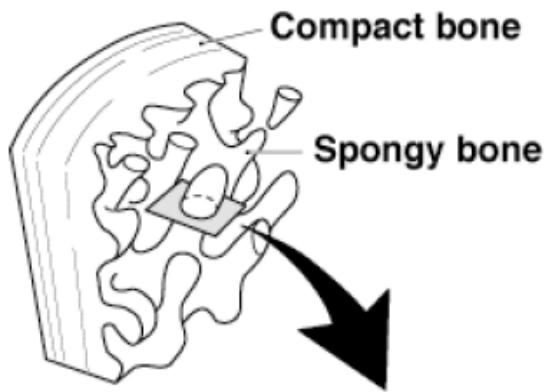




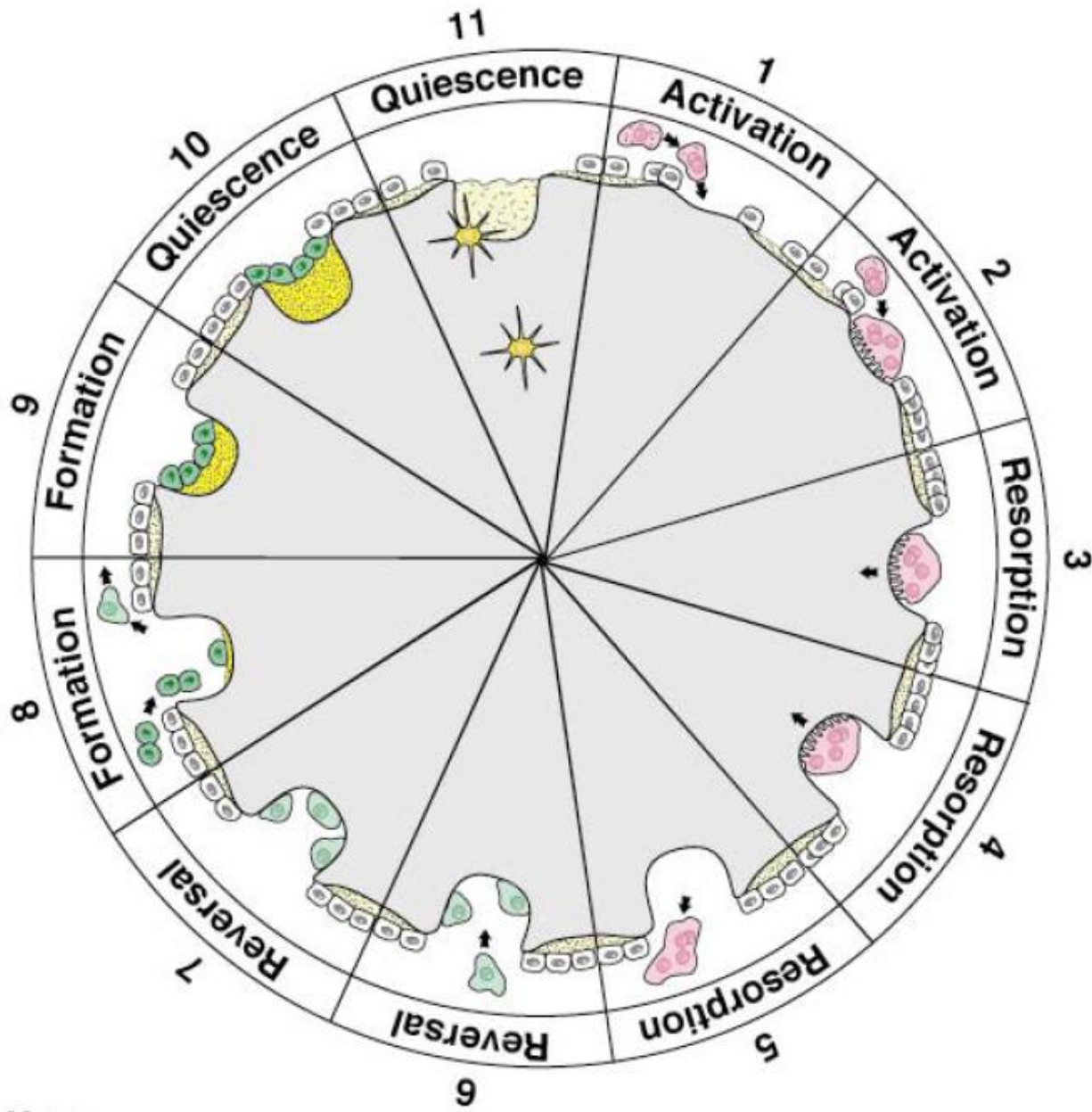
### ACTIVITY 3D: HEALTHY BONE REMODELING THE OSTEO BLASTER/CLUSTER WHEEL

#### STUDENT HANDOUT


Carefully cut out the cover for the Osteo Blaster/Cluster Wheel that is provided below. Push a two-prong brad through the dot in the center of the cover and then attach the cover to the base page. The “wheel” you have constructed will be used to learn about the events that occur during normal bone remodeling, maintenance, and repair. Set the “window” over section one and prepare for the activity that follows.









**Key:**


 Lining cells (epithelial cells)

 Pre-osteoclasts


 Osteoclasts

 Mononuclear cells

 Osteoblasts

 Non-mineralized bone matrix (osteoid)

 New-mineralized bone matrix

 Osteocytes



## ABNORMAL BONE REMODELING

### Key Concept—Coupling

Osteoblasts and osteoclasts work together. Their activities in building and resorbing bone are said to be “coupled.” When appropriately coupled, bone remodeling is in balance and there is no net gain or loss of bone mass. Osteoblast and osteoclast activity may become uncoupled in certain diseases.

While healthy bone remodeling occurs at many simultaneous sites throughout the body, there are instances wherein “disordered coupling” or abnormal remodeling occurs. This imbalance in the osteoclast and osteoblast activity affects bone health by leaving bone more fragile, more prone to breaks even during the most common of events — such as slipping from a curb, turning an ankle, even a hearty sneeze!

In one instance, the “disordered coupling” is due to a decrease in the osteoblast activity, even though osteoclasts are behaving normally. This reduced “blast” activity replaces only some of the bone tissue removed by the “clast” activity. The osteoclasts resorb the bone tissue as in normal bone remodeling, but the osteoblasts cannot keep up with the tissue loss. The osteoblast activity level is decreased. Thus resorption pits are not filled completely and bone becomes weakened. This phenomenon occurs during the aging process, but can also occur earlier in life due to excessive consumption of alcohol.

In the second instance, the “disordered coupling” is caused by excessive osteoclast activity, while the osteoblast activity remains “normal.” In other words, the osteoclasts dig out resorption pits that are much deeper than those that occur during normal bone remodeling. The osteoblast, while working to full capacity, cannot fill these deeper pits. Once again, the bone becomes weakened. This phenomenon normally occurs in women during and following menopause. It also occurs in those who suffer with *anorexia nervosa* or in those whose parathyroid glands do not function properly (hyperparathyroidism). One other condition in which the “clast” activity is excessive is in the disease known as osteoporosis.

Examine the chart provided which depicts the slight, but important changes that occur during the five phases in the bone remodeling process: ACTIVATION, RESORPTION, REVERSAL, FORMATION, and QUIESCENCE. Compare this with the chart provided in Activity 3D.

Create your own copy of *Abnormal The “Osteo Blaster/Cluster” Wheel*. Work with a partner. One person will complete “Wheel A” to look at the phase events in the normal aging process and those in the case of alcohol abuse. The other partner will complete “Wheel B” to examine the phase events that occur during osteoporosis, menopause, anorexia, and parathyroid hormone imbalance.

The information on the Abnormal Bone Remodeling Chart in this section describes some of the events that occur during abnormal bone remodeling or “disordered coupling.” Use this chart to describe what students will be seeing in wheels “A” and “B.” After the information for all eleven sections is discussed, complete *The Triple Venn Diagram Worksheet*.

## ABNORMAL BONE REMODELING CHART

**Abnormal Bone Remodeling- “Disordered Coupling”**  
*Imbalance in Osteoblasts and Osteoclasts, “blast/clast,” activity*

– PHASE –

– PHASE EVENTS –

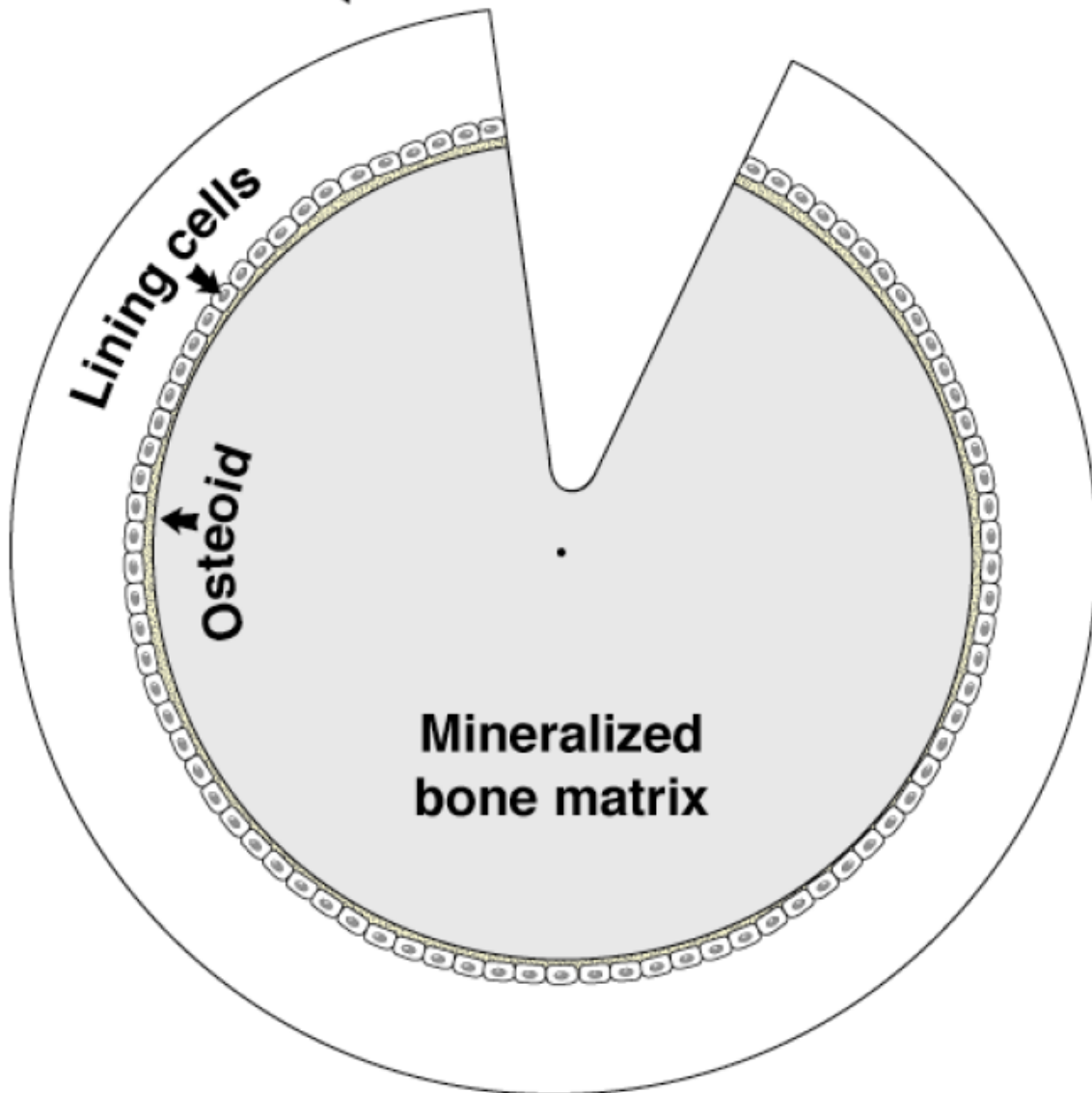
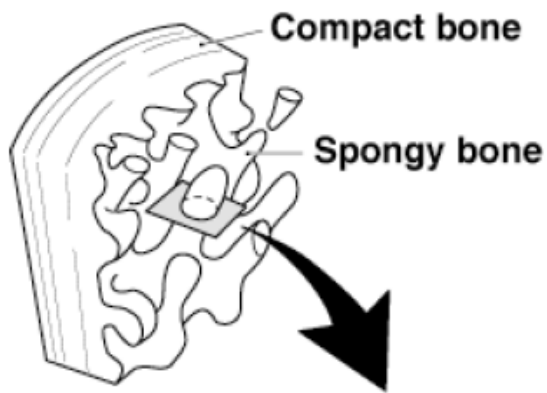
|                   | Usual Aging Process or<br>Alcohol Abuse<br>“Clast” activity normal; “Blast activity decreased   | Osteoporosis, Menopause, <i>Anorexia Nervosa</i> , Hyperparathyroidism<br>“Clast” activity excessive; “Blast activity normal  |
|-------------------|---|---|
| <b>ACTIVATION</b> | 1. Pre-osteoclasts are attracted to <i>fewer</i> remodeling sites.  | 1. Pre-osteoclasts are attracted to <i>increased</i> remodeling sites.  |
|                   | 2. Pre-osteoclasts fuse to form multinucleated osteoclasts.   | 2. Pre-osteoclasts fuse to form multinucleated osteoclasts.   |
| <b>RESORPTION</b> | 3. Osteoclasts dig out a cavity, called a resorption pit, in spongy bone or burrow a tunnel in compact bone.  | 3. Osteoclasts dig out a cavity, called a resorption pit, in spongy bone or burrow a tunnel, but <i>too much activity...</i>  |
|                   | 4. Calcium can be released into the blood for use in various body functions.  | 4. ... <i>makes pit or burrow deeper</i> which erodes tissue; calcium can be released into the blood for use in various body functions.   |
|                   | 5. Osteoclasts disappear.   | 5. Osteoclasts disappear.   |
| <b>REVERSAL</b>   | 6. Mesenchymal stem cells, <i>pre-cursors</i> to osteoblasts, appear along the burrow or pit where they...  | 6. Mesenchymal stem cells, <i>pre-cursors</i> to osteoblasts, appear along the burrow or pit where they...  |
|                   | 7. ... <i>proliferate</i> (increase in numbers) and <i>differentiate</i> (change) into pre-osteoblasts, then ....   | 7. ... <i>proliferate</i> (increase in numbers) and <i>differentiate</i> (change) into pre-osteoblasts, then ....   |
| <b>FORMATION</b>  | 8. <i>mature</i> into osteoblasts at the surface of the burrow or pit, but ...  | 8. <i>mature</i> into osteoblasts at the surface of the burrow or pit, but ...  |
|                   | 9. ... with <i>decreased osteoblast activity</i> release <i>some osteoid</i> to form a new soft nonmineralized matrix, but cannot restore the burrow or pit to its original status. | 9. ... while <i>normal osteoblast activity</i> releases adequate <i>osteoid</i> to form a new soft nonmineralized matrix, it is not enough to restore the burrow or pit to its original status. |
|                   | 10. The new matrix is mineralized with calcium and phosphorous.   | 10. The new matrix is mineralized with calcium and phosphorous.   |
| <b>QUIESCENCE</b> | 11. Site, with resting lining cells, remains <i>dormant</i> , but <i>not completely filled</i> , awaiting the next cycle.   | 11. Site, with resting lining cells, remains <i>dormant</i> , but <i>not completely filled</i> , awaiting the next cycle.   |



## THE OSTEO BLASTER/CLUSTER WHEEL

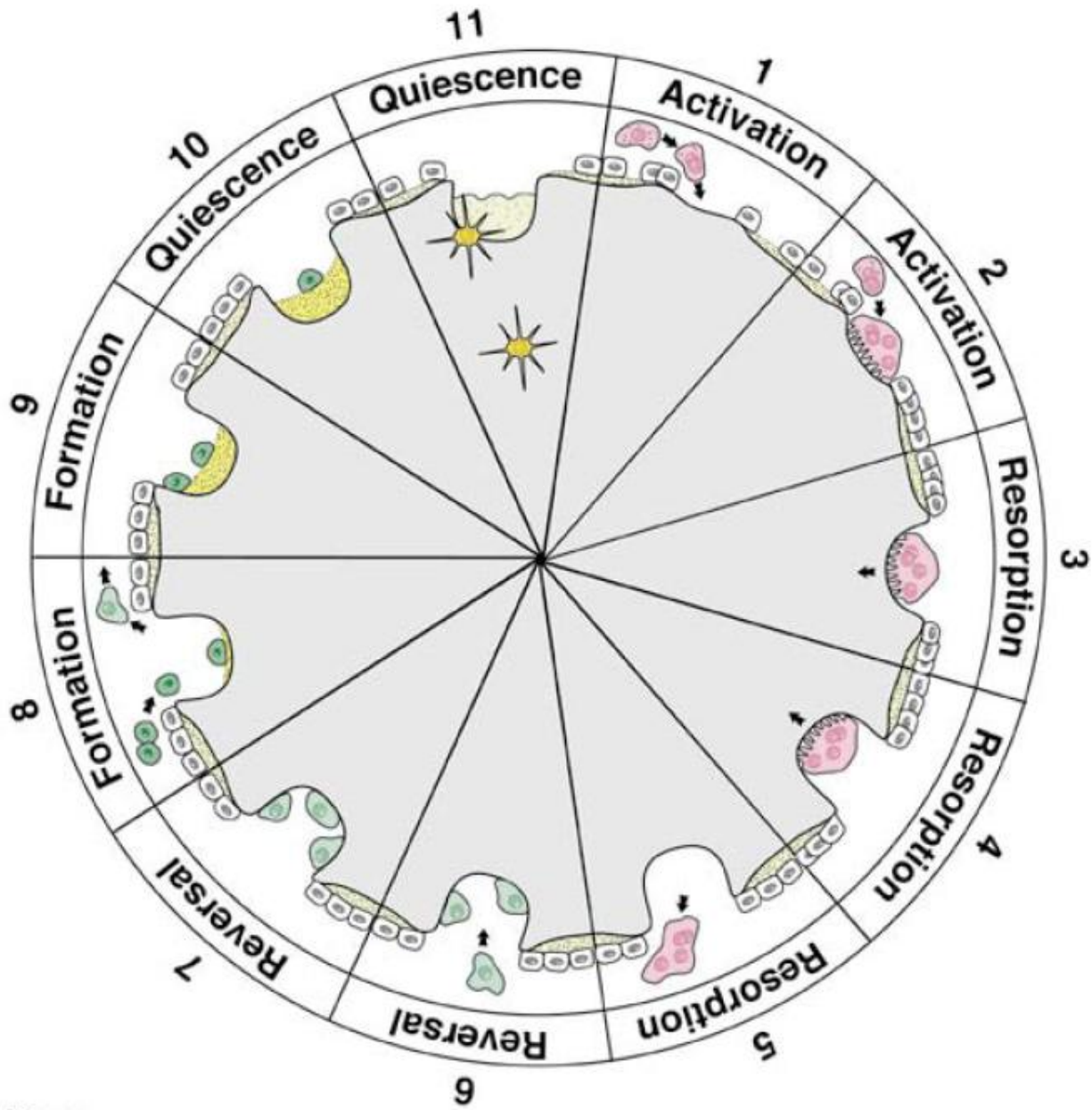
### STUDENT HANDOUT

Carefully cut out the cover for the Osteo Blaster/Cluster Wheel that is provided below. Push a two-prong brad through the dot in the center of the cover and then attach the cover to the base page. The “wheel” you have constructed will be used to learn about the events that occur during normal bone remodeling, maintenance, and repair. Set the “window” over section one and prepare for the activity that follows.













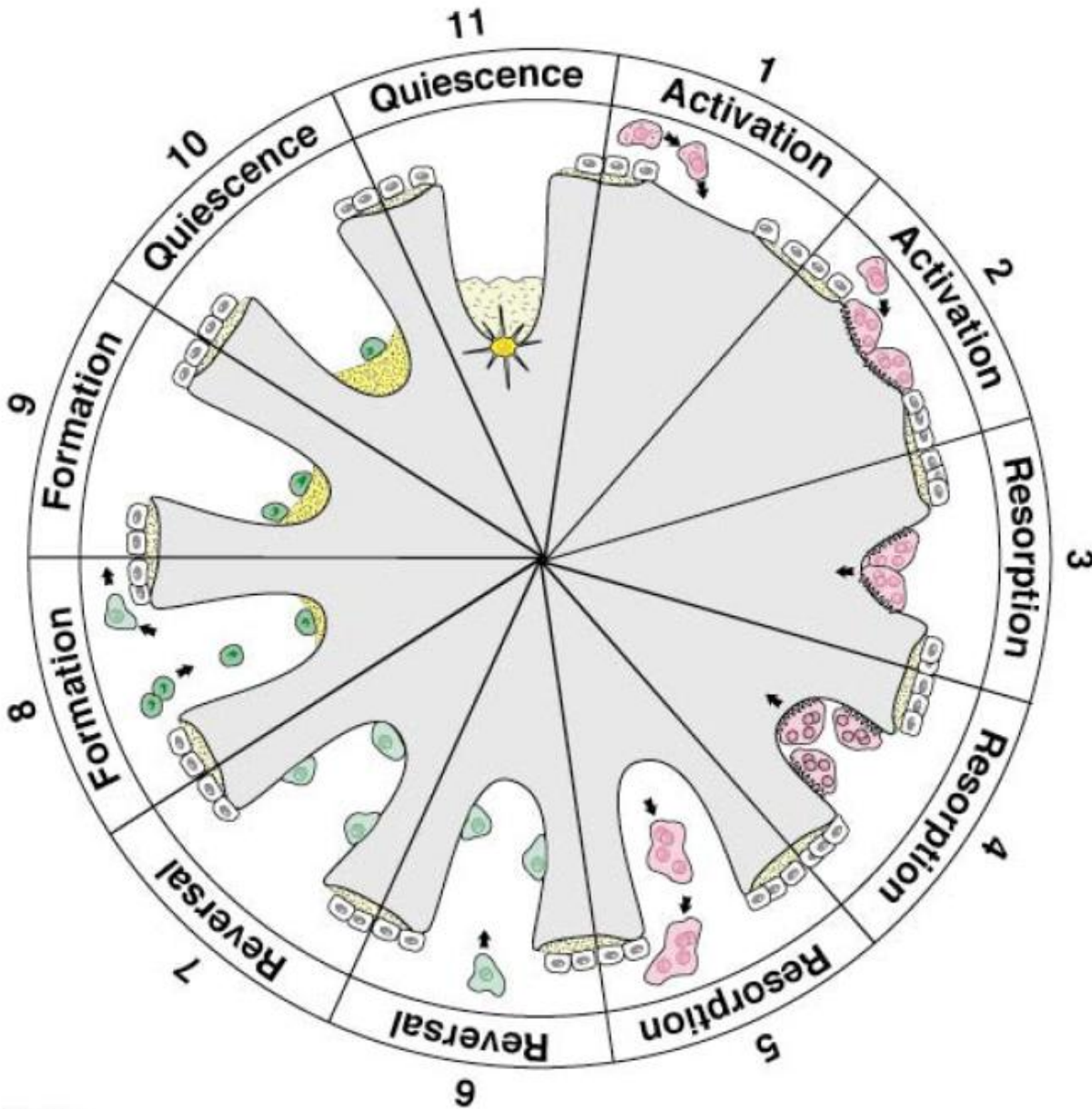
# Wheel A: Usual Aging Process or Alcohol Abuse











## Key:

-  Lining cells (epithelial cells)
-  Osteoblasts
-  Pre-osteoclasts
-  Non-mineralized bone matrix (osteoid)
-  Osteoclasts
-  New-mineralized bone matrix
-  Mesenchymal stem cells
-  Osteocytes

Wheel B: Osteoporosis, Menopause, Anorexia Nervosa, Parathyroid Hormone Imbalance



Key:

- |   |   |
|---|---|
|  Lining cells (epithelial cells) |  Osteoblasts                           |
|  Pre-osteoclasts                 |  Non-mineralized bone matrix (osteoid) |
|  Osteoclasts                     |  New-mineralized bone matrix           |
|  Mesenchymal stem cells          |  Osteocytes                            |

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

## HEALTHY BONE REMODELING

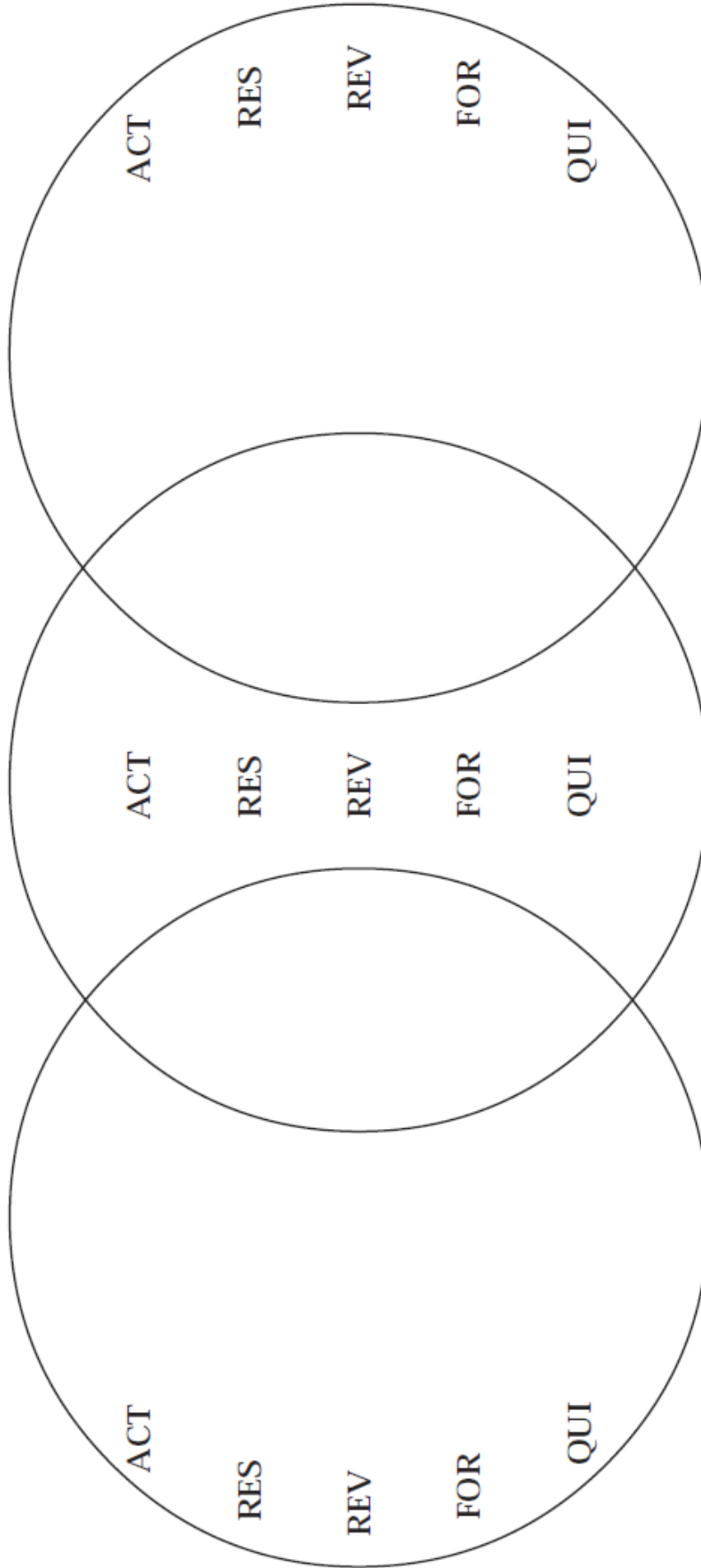
After listening carefully to the description of healthy bone remodeling, complete the following statements as you review the events depicted in *The Osteo Blaster/ClusterWheel* that you have constructed. Refer to the key for help with terms.

1. During the Activation Phase, the \_\_\_\_\_ are attracted to the remodeling sites.
2. The pre-osteoclasts become fused and form \_\_\_\_\_ osteoclasts.
3. During the Resorption Phase, the osteoclasts dig out a cavity called a \_\_\_\_\_ pit.
4. As the pit is being dug out, an important mineral, \_\_\_\_\_, is absorbed into the blood for use by the body.
5. After the pit is completed, the \_\_\_\_\_ disappear.
6. In the Reversal Phase, \_\_\_\_\_ cells appear along the burrow or pit.
7. The cells along the pit prepare the surface for new bone \_\_\_\_\_.
8. During the Formation Phase, the osteoblasts are \_\_\_\_\_ to the surface of the pit or burrow.
9. The osteoblasts busy themselves with replacing the removed bone tissue with a new soft matrix, or \_\_\_\_\_.
10. This phase must be called the \_\_\_\_\_ Phase because the new matrix becomes mineralized with calcium and phosphorus thus creating new bone.
11. The remodeling site (now new bone tissue) remains \_\_\_\_\_ until the next bone remodeling cycle begins.

*Now, use your wheel to try to teach someone else about normal bone remodeling and the balance between the work of the osteoclasts and osteoblasts in bone tissue.*

# COMPARE AND CONTRAST

Abnormal Bone Remodeling "A"      Normal Bone Remodeling      Abnormal Bone Remodeling "B"



**KEY:** Activation phase      ACT  
 Resorption phase      RES  
 Reversal phase      REV  
 Formation phase      FOR  
 Quiescence phase      QUI



Name \_\_\_\_\_

## Types of Muscle & Muscle Movement

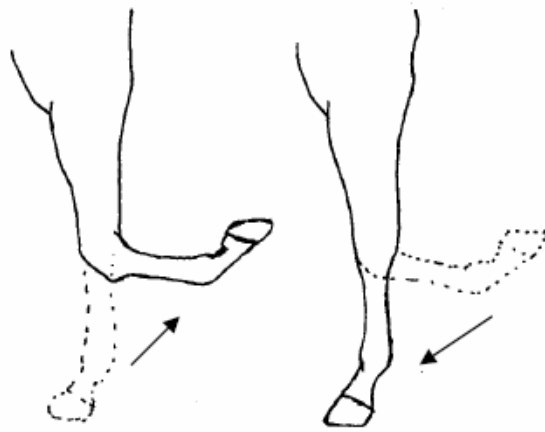
**Directions:** Explain the function of the three types of muscle in the spaces below.

Skeletal Muscle \_\_\_\_\_

Cardiac Muscle \_\_\_\_\_

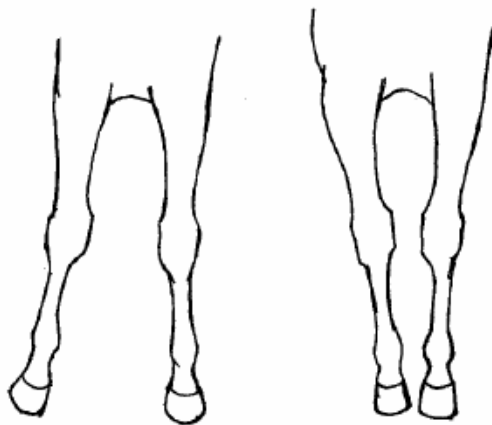
Smooth Muscle \_\_\_\_\_

**Muscle Movement**



Flexion

Extension



Abduction

Adduction

Name \_\_\_\_\_

## Major Muscles

**Directions:** Label the major muscles.

Masseter

Deltoid

Trapezius

Intercostal

External abdominal oblique

Gluteals

Gastrocnemius

Brachiocephalicus

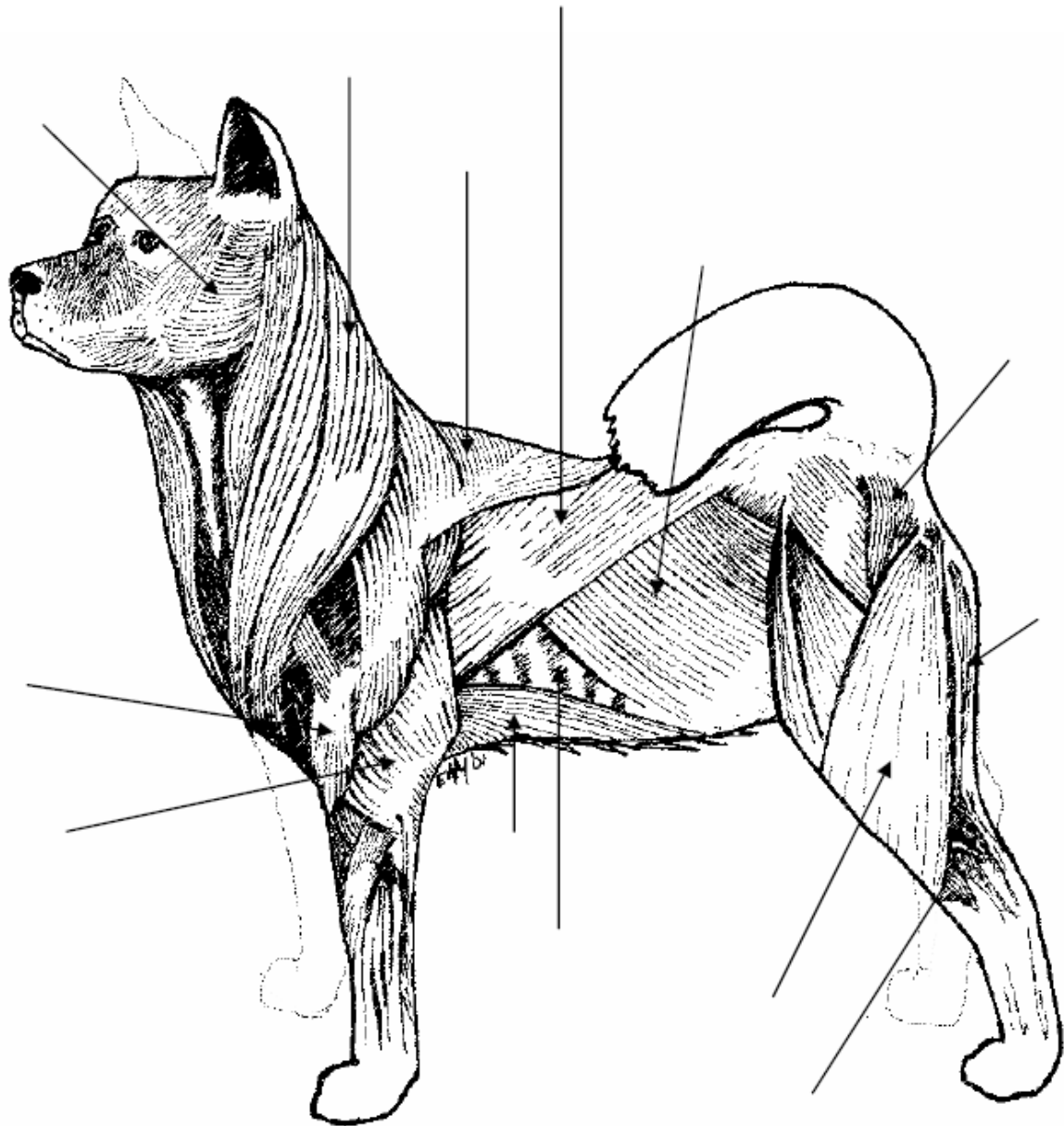
Triceps brachii

Latissimus dorsi

Pectoral

Biceps femoris

Semitendinosus



Name \_\_\_\_\_

Partners Names \_\_\_\_\_

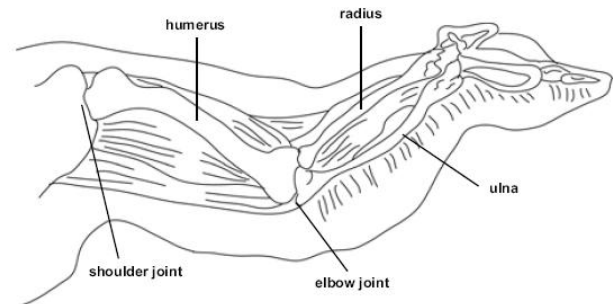
## Chicken Wing Dissection Lab

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### Objectives:

- Observe the skin, muscles, bones, and joints of a chicken wing.
- Relate the structure of a bird's wing to its function.
- Compare and contrast the range of motion of a bird's wing with that of the human arm.
- Observe the movement of opposing pairs of muscles.

**CAUTION:** Even though the wing was soaked in alcohol handle the chicken wing and dissection tools only when wearing disposable gloves. Raw chicken often carries *Salmonella* bacteria, which can make you very ill. Do not touch your mouth with your hands or the tools during this lab. Remember that scalpels and scissors are sharp.



### Procedure:

1. Put on the disposable gloves and examine the chicken wing.
2. Observe the skin. Record your observations.
3. Remove as much skin from the wing as you can. Try not to damage any underlying structures. Use the small scissors and start at the shoulder and work your way across.  
**Hint: Always keep the scissor tips up to avoid damage.**
4. In the Data section draw a diagram of the wing, labeling as many joints and parts as you can.
5. Locate the muscles in the wing and tug each one gently. Observe and record what happens to the rest of the wing when you tug. Determine the flexor and extensor muscles and label on diagram.  
**Hint: Hold the wing up by the ball socket, you will be able to see movement clearly.**
6. Locate and diagram the tendons, the white ribbon like structures that attach the muscle to the bones. Determine where each tendon connects to a bone. Label on diagram
7. Cut through the middle of a muscle that you have identified as a flexor for the upper wing. What happens to the wing?
8. Cut through the middle of a muscle that you have identified as an extensor for the lower wing. What happens to the wing?

9. Remove the muscles to expose the bones and joints. Find the ligament (the tough shiny structures connecting the bones). Draw another diagram of the wing, labeling the bones, joints, and ligaments.

10. 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? What type of joint is this? How can you tell?

### **Diagrams and Analyzing Data:**

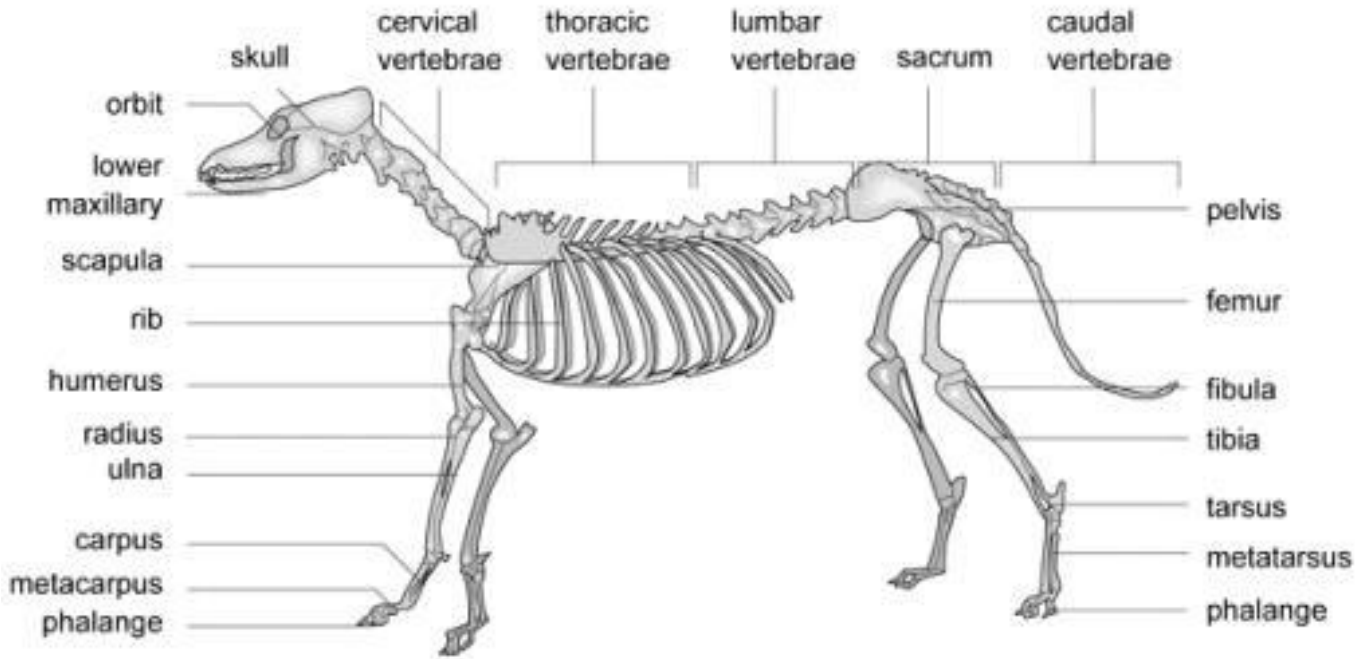
Draw a picture of your chicken wing:

1. What part of a dog's anatomy is similar to the chicken wing?

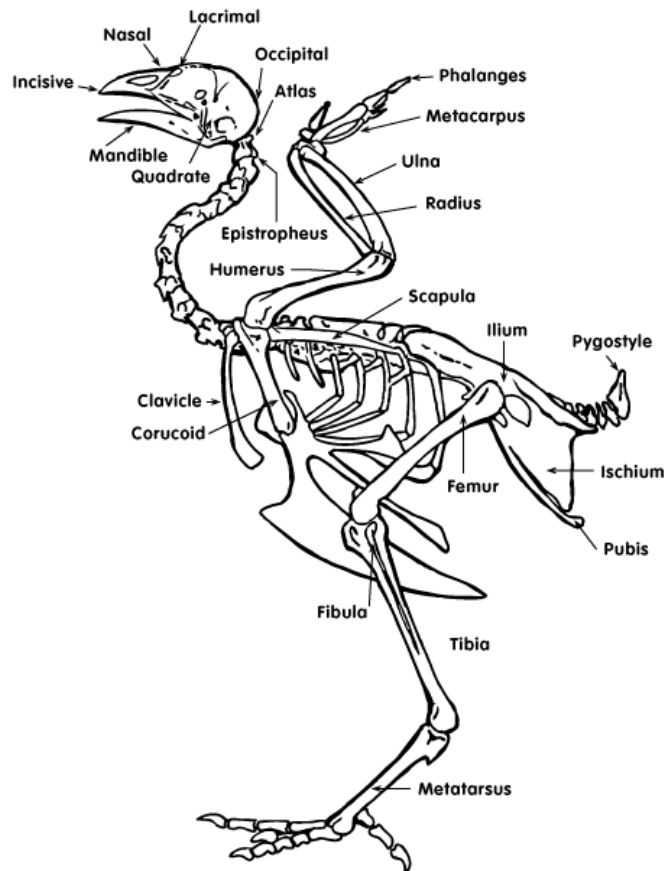
2. How many parts of a chicken wing correspond to a dog? Make a table showing them

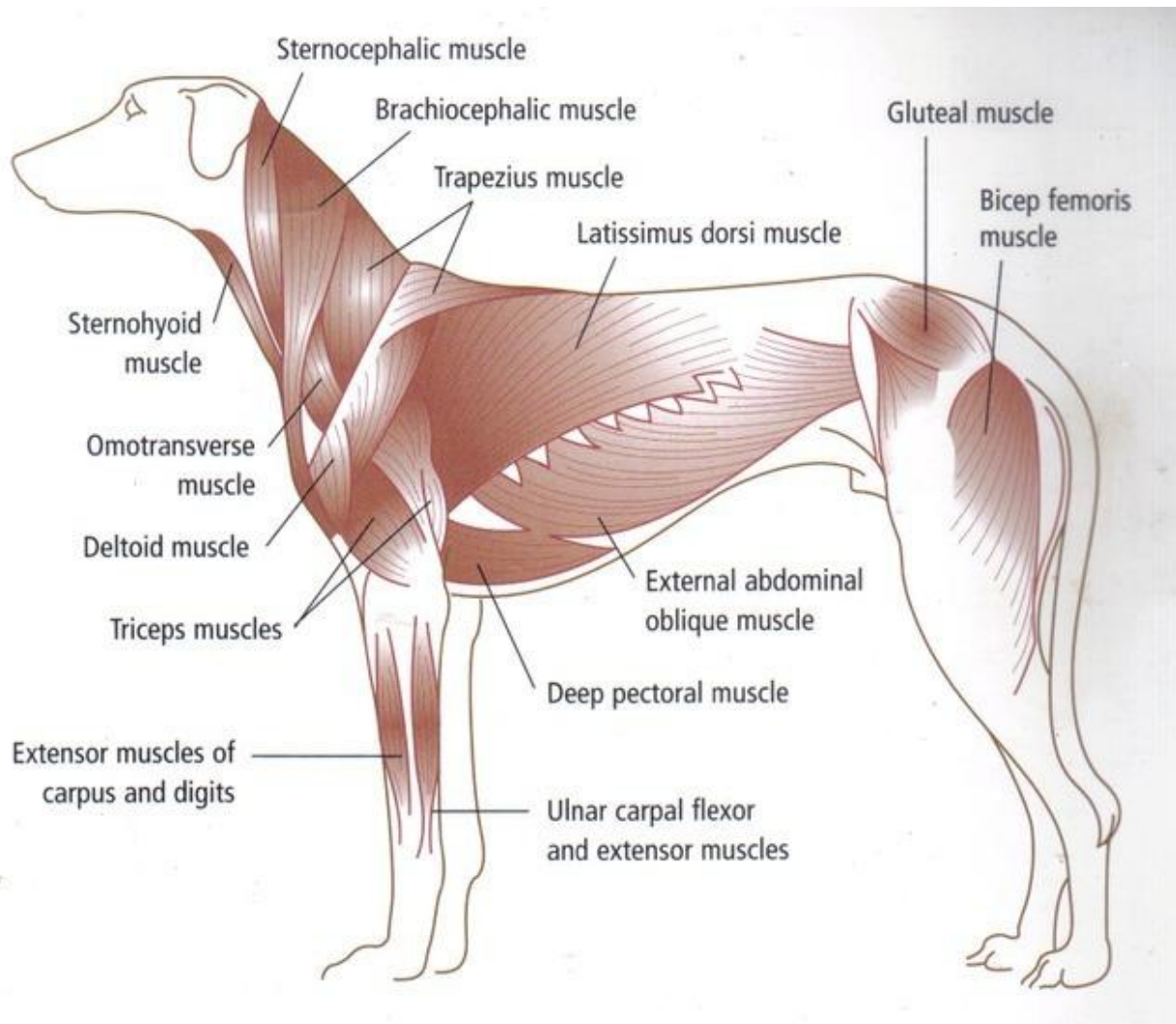
3. Compare the movements of a chicken wing with the corresponding part of the dog's body. What are the similarities? What are the differences?

## SKELETON OF A DOG



## Chicken Skeleton





## The Major Muscles

