

Physiology Honors Lab Manual 2014-15 Semester I

Science Department
TOHS
CVUSD



Thousand Oaks High School
Science Department
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Compiled by:

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This Lab manual has been designed for Anatomy and Physiology Honors and CP students at Thousand Oaks High School. They may print out the lab handouts, data tables, and lab worksheets and use them in the lab with Dr. Malhotra's permission. These print outs will not count as their prelabs.

Welcome to Dr. Malhotra's Anatomy/Physiology CP and Physiology Honors courses at TOHS! I look forward to teach you and learn from you as we move ahead in this course. Remember, we all are life-long learners!

This lab manual is dedicated to all my students in anatomy CP/physiology H classes at TOHS! Some labs will be used for honors course only and others may be common to honors and CP courses. The honors students are expected to learn all the material in more depth and challenge themselves by using critical thinking and real life applications of different protocols and data analysis. I hope this lab manual is helpful in completing your prelabs and labs for these courses.

Due to the volume of material covered, length and complexity of labs, these courses are fast paced. Please be prepared to move with the class and complete your assignments and lab write-ups on time so that you don't get left behind.

To be successful in the lab, you must be a good team player in your lab group and in the class. Always follow the lab safety rules while doing your lab.

During the lab if you finish your part before someone else, there are several things you can do to help the teacher or your classmates:

- a. Help someone else in your group
- b. Clean up something for your group: wash glassware, turn off and unplug hotplate, cover beakers, wipe off countertops, clean out sinks, wipe off outside of bottles, put equipment back where you found it etc...
- c. Clean up something for the class
- d. Organize lab handouts/assignments for the next class
- e. REMEMBER! NO ONE LEAVES UNTIL EVERYTHING IN THE CLASS IS CLEANED UP AND PUT BACK IN ITS PLACE!

I hope this course is a learning and rewarding experience for you this year!

Lab Safety

- This Lab Safety Section is designed to review a few of the lab safety rules and procedures. For a complete explanation of all rules and procedures, please read the course guidelines given by your instructor. You are responsible for your behavior in the lab. Failure to follow safety rules endangers the safety of everyone in the room, so such behavior will not be tolerated and may result in a failing grade for the course
- Familiarize yourself with the location of fire extinguishers, fire blanket, eye wash station (located at the sink against the wall), and emergency exits (in the back of the lab).
- Turn off cell phones during lab so that you don't miss important information from your instructor.
- Eating, drinking (even water), and smoking are prohibited in the lab.
- Safety goggles MUST be worn during some of the labs, as indicated by your instructor.
- Secure long or loose hair, clothing, and jewelry.
- Shoes must be worn at all times in the lab especially during dissections.
- Do not dump any solid waste (animal or paper) in the sinks. Use the sink assigned to your group.
- Store coats, etc. appropriately - not in the aisles or on the lab table.
- Read lab instructions before you begin the lab; when in doubt, ask your instructor.
- If there is fire in the building, evacuate the building immediately
- If you spill a flammable liquid, inform your instructor
- No eating, drinking, chewing gum, applying make-up in the lab
- Do not perform experiments that the teacher doesn't tell you to do
- If there is fire on lab materials, its best to use fire extinguisher
- Use the dissection tools carefully. If hurt or cut, tell the teacher immediately
- Never use volatile substances near the flame
- Dry hands before touching electrical outlets
- Any spills on the floor, must be cleaned at once
- If acid is spilled on the skin, wash with water
- Spilled acids can be made safe with sodium bicarbonate solution
- Spilled bases can be neutralized with acetic acid (vinegar)
- Each student must help clean up the lab; do not work alone in the lab.
- The clean up group must check the final clean up after each lab
- Smell the liquid facing the container away from your nose
- All trash and chemicals go in proper containers
- Wipe your lab stations; Wash all lab supplies and return to the lab tray or side counters
- Keep glassware, computers and microscopes away from edges of the lab table
- Broken glassware: sweep up and put into broken glass container on the back counter
- If you get any chemicals in the eye, wash for at least 15 minutes with tap water
- Before using an instrument or machine, be sure you know how to turn it off in case of emergency
- When removing an electrical plug from its socket, grasp the plug, not the electrical cord
- Use the sink assigned to your lab group and never put solids in the sinks
- After working with bacteria or dissecting a specimen, disinfect lab tables and counters
- Put your safety goggles back in the cabinet/box only when your teacher says it is OK to do so
- Always wash your hands before leaving the lab!
- During laptop computer labs, remove computers from the cart according to assigned #
- If you are the last class of the day, it is your responsibility to put your computer back on the cart.



The Bone Identification Lab Part 1

Objectives: Answer the following questions for each station and then do the analysis questions:



- a. Name the bone(s) at each station
- b. Where is this bone located in the human body?

Analysis questions:

- Station 1: Which three bones are fused together to form this structure?
- Station 2: How many vertebrae are fused together to form this bone?
- Station 3: How many of these structures are present in the human skeleton?
- Station 4: Does this structure have any body? What is its function?
- Station 5: What structure is formed by these bones?
- Station 6: What tissue are these structures made up of?
- Station 7: What are the characteristic features of this structure?
- Station 8: What is the characteristic feature(s) of this structure?
- Station 9: What kind of joint does this bone form? Name the structure at its proximal end.
- Station 10: Is this the left or right hand? How do you know?
- Station 11: What kind of bone is this? What is its common name?
- Station 12: Name the bones that form a joint with this bone.
- Station 13: Is this bone located on the medial or lateral (thumb) side of the arm?
- Station 14: Is this a long or a short bone? What is its common name?
- Station 15: How is this structure adapted or modified to support the body weight? Does it have any transverse foramen?
- Station 16: Identify #s 1, 2, and 3 on this structure. What is its function?

The Bone ID Lab part 2

Identify the following bones and numbered parts on each. Answer all questions on the sheet provided by your instructor.



Fig.1

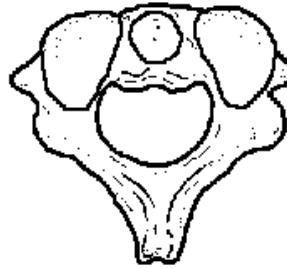


Fig. 2

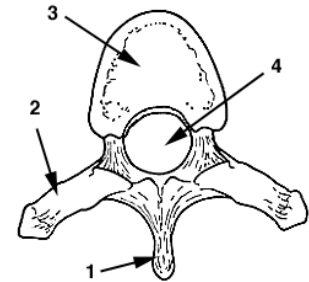


Fig. 3



Fig. 4

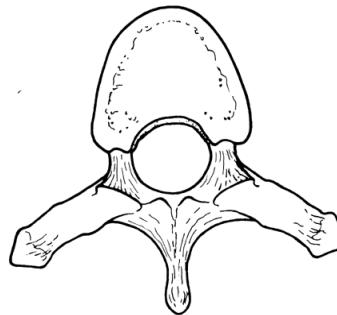


Fig. 5



Fig. 6

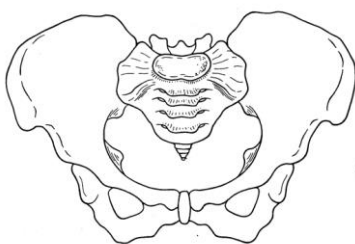


Fig. 7

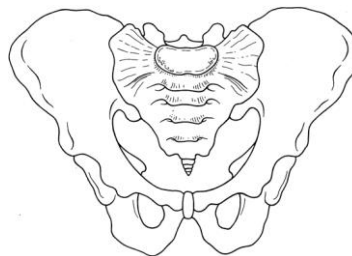


Fig. 8

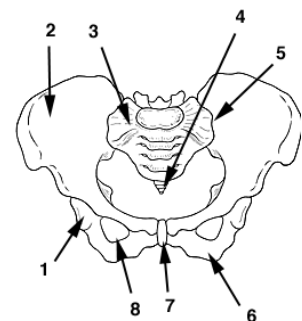


Fig. 9

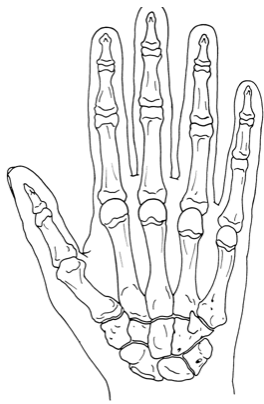


Fig. 10

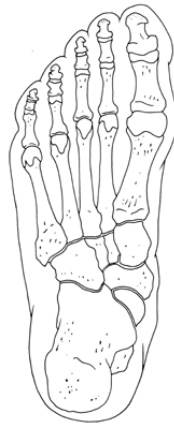


Fig. 11

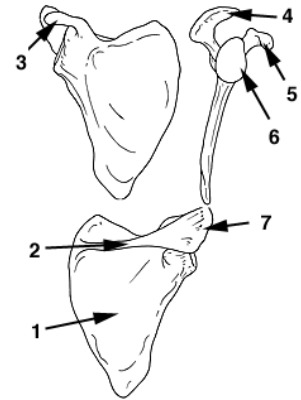


Fig. 12

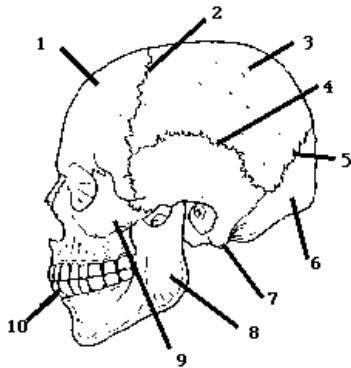


Fig. 13

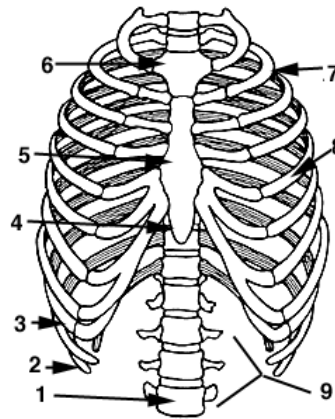


Fig. 14

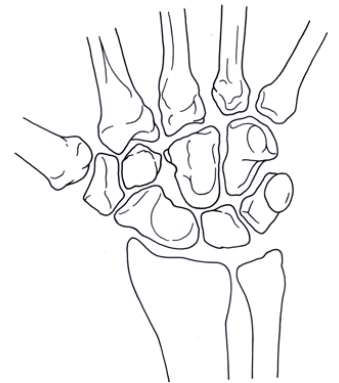


Fig. 15

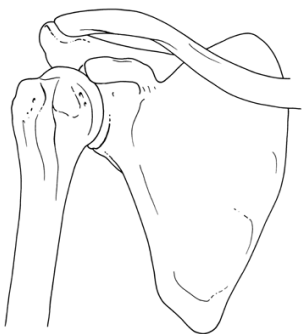


Fig. 16

Bone ID Lab part 2 –Questions

Using the above pictures, answer the following questions on your answer sheet.

- Fig. 1: a. Name this bone. b. What is a unique feature you see in this structure?
- Fig. 2: a. Identify this bone. b. Name the process that is not present in any other vertebra.
- Fig. 3: a. Identify the numbered parts in this bone. b. What is the function of part 3?
- Fig. 4: a. Name the long bone shown in this picture. B. What type of 2 joints are depicted here?
- Fig. 5: a. What type of vertebra is this? b. How do you know?
- Fig. 6: a. What is wrong with this picture? b. Name the little round bone in this picture.
- Fig. 7: a. Is this a male or a female pelvic girdle? b. What is the advantage of having this type of girdle?
- Fig. 8: a. Is this a male or a female girdle? b. How do you know?
- Fig. 9: a. Name the parts with #s: 2, 3, 4, 8.
- Fig. 10: a. Is this a left or a right hand? b. How many carpals are seen here? c. How many metacarpals?
- Fig. 11: a. Is this a left or a right foot? b. How many tarsals are seen here? c. What is the heel bone called?
- Fig. 12: a. Name the bone shown in this picture. b. What are the parts with numbers: 3, 6, 7?
- Fig. 13: a. Name the parts with numbers: 1, 2, 4, 5, 6, and 9.
- Fig. 14: a. Name the structures with numbers: 2, 4, 5, 6. Is # 8 a long or a short bone?
- Fig. 15: a. What part of the human skeleton is this? b. Name the structure made up of 8 little bones.
- Fig. 16: a. What kind of joint is shown in this picture?



The Bone Observation and Dissection Lab

Objectives: Observation of a longitudinally sectioned beef bone
Study the bone matrix, bone histology, human x-rays, and fractures

Materials: Beef bone, dissection tools, dissection tray, microscope, slide, and cover slip, chicken legs, x-rays.

Procedure:

1. Obtain a longitudinally sectioned beef bone for your lab group.
2. Examine the external anatomy of the bone.
3. Draw and label the external structures of the bone.
4. Identify all the parts shown in figure.1

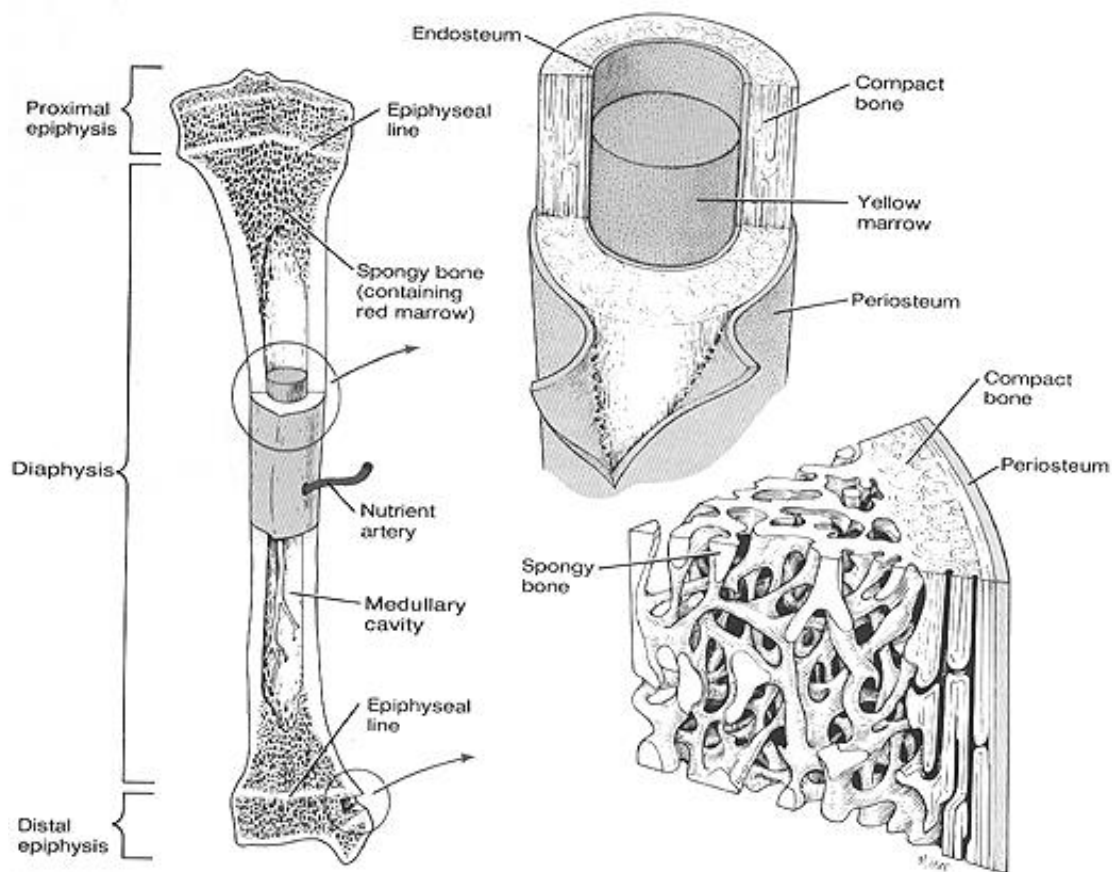


Figure 1

Analysis questions

Part 1 – Observation of a longitudinally sectioned beef bone

1. Where in the human skeleton are long bones found?
2. Distinguish between the epiphysis and the diaphysis of a long bone.
3. Where is cartilage found in a bone?(2 places, but not the epiphysis)
4. What is the color of the articular cartilage?
5. Approximately how thick is this cartilage?
6. What is the purpose of this cartilage?
7. What type of bone tissues is found in the epiphysis?
8. What type of bone tissues is found in the diaphysis?
9. What differences do you note between the macroscopic structure of compact bone and spongy bone?
10. How are these differences related to the functions of these types of bone?
11. How thick is the epiphyseal disc (plate) on the bones?
12. How thick is the compact bone along the diaphysis at its thickest point?
13. How thick is the compact bone of the diaphysis at its thickest point?
14. What is the diameter of the bone at its diaphysis?
15. How much of that is the medullary cavity (%)?
16. What type of marrow is found in the medullary cavity?
17. Describe the appearance and texture of the marrow in the cavity?
18. What evidence do you have that blood does indeed flow throughout the interior of the bone?
19. Describe the appearance of the periosteum?

20. How thick is the periosteum?
21. Try pulling a piece of the periosteum away from the shaft of the bone. Was it difficult? Why do you think?
22. Draw a section of the diaphysis of a adult bone. Use the measurements you obtained in #'s 13, 14, and 15 and list them on your scale drawing. Label the following parts as well: compact bone, periosteum, medullary cavity.

Part 2 - Components of bone matrix

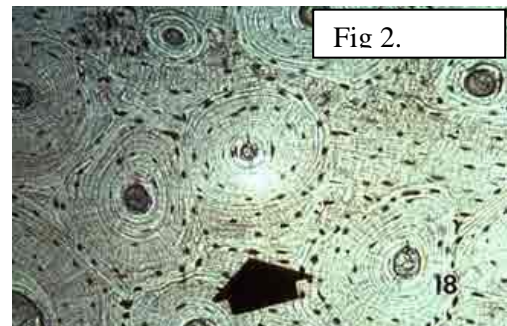
23. Observe a baked chicken bone. Describe its texture. Determine how easily it breaks by attempting to break a small section of the bone. Explain why this occurs as it does. Look inside the medullary cavity. Describe what has happened to the yellow marrow.
24. Observe a chicken bone that has been soaking in a weak acidic solution for at least 24 hours. Describe its texture. Attempt to break it. Describe what happens and explain why this occurs.
25. What physical properties are given to bone by the presence of collagen and apatite?

Part 3 – Bone Histology

26. Prepare a wet mount of the bone tissue. Examine bone tissue on medium and high powers on the microscope. Draw three osteons in proper relationship to each other. Label and then define the structures listed below your drawing. Color your drawing using your colored pencils.

Label and define:

27. Lacunae -
28. Osteocyte -
29. Osteonic canal -
30. Canaliculi -
31. Lamella -
32. Matrix -

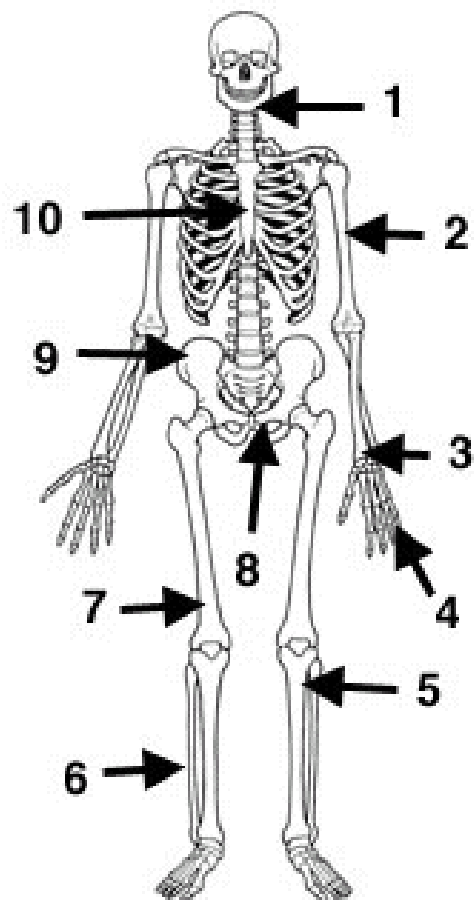
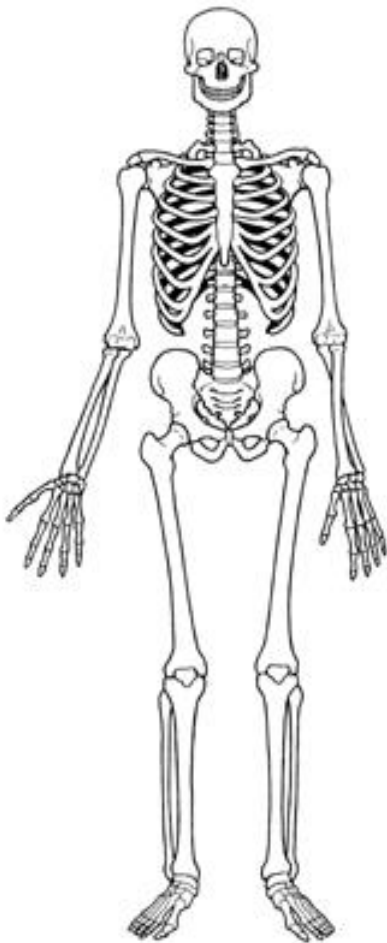


33. What type of bone tissue have you drawn? (spongy or compact)

Skeleton Review worksheet-1

Use the following pictures for practicing for your bone practical exams! Label each and every bone and major bone markings you can see in the following skeletons.

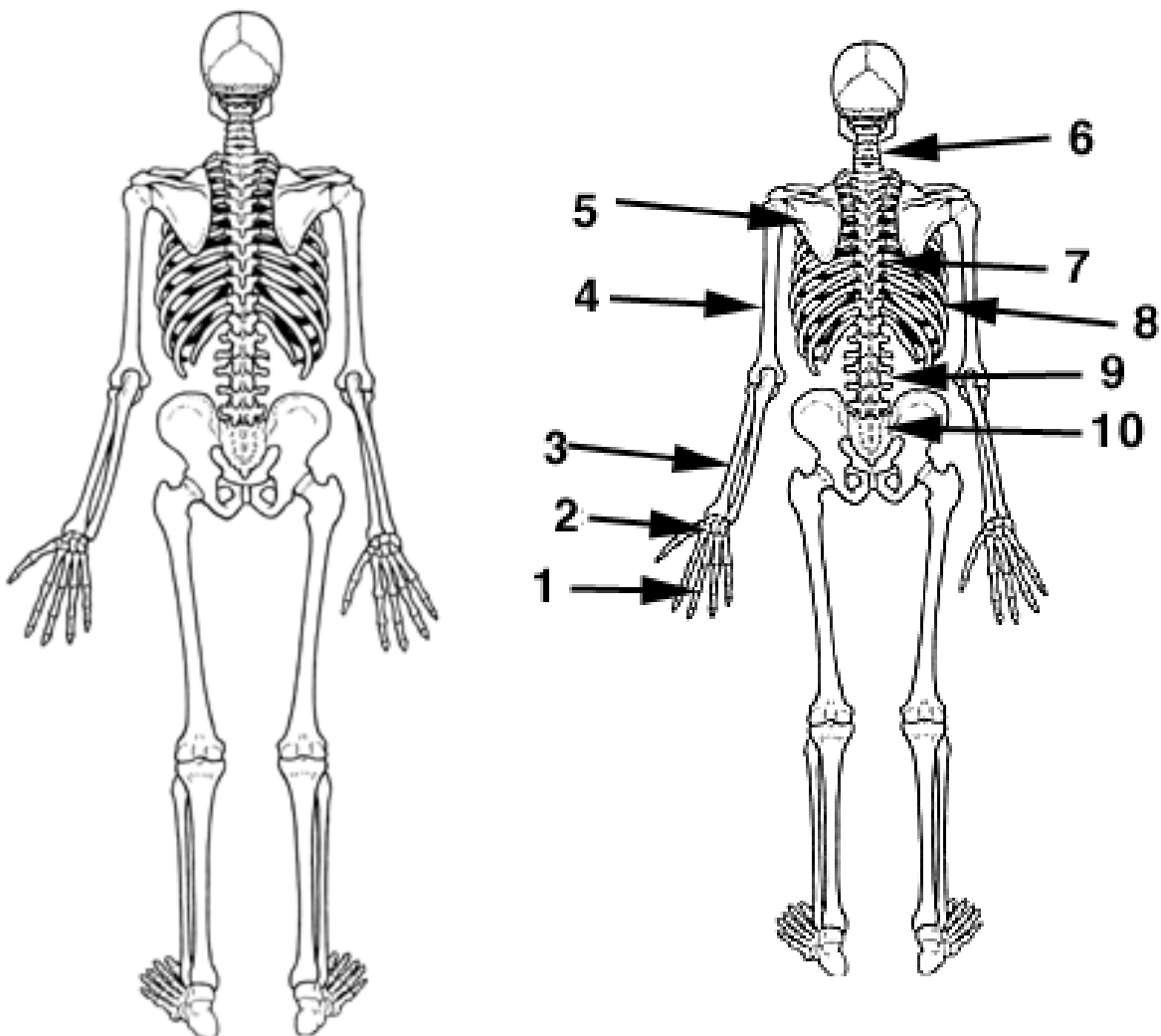
Anterior view of the human skeleton



Skeleton Review worksheet-2

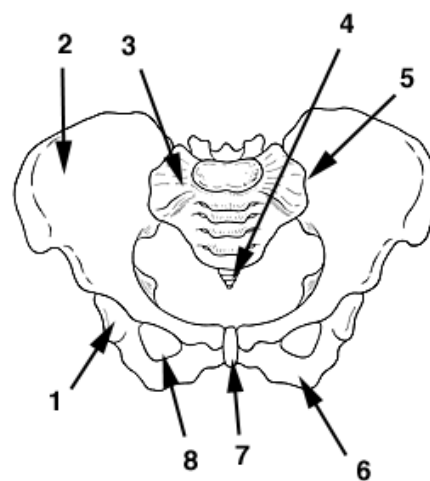
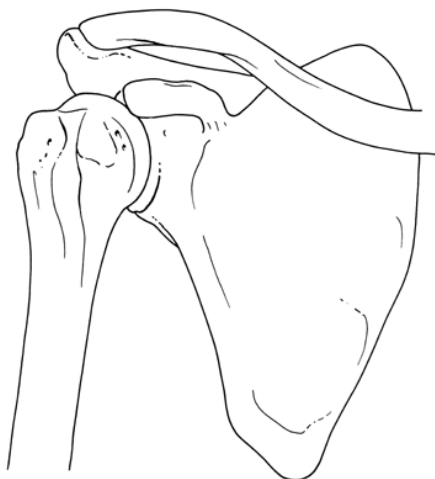
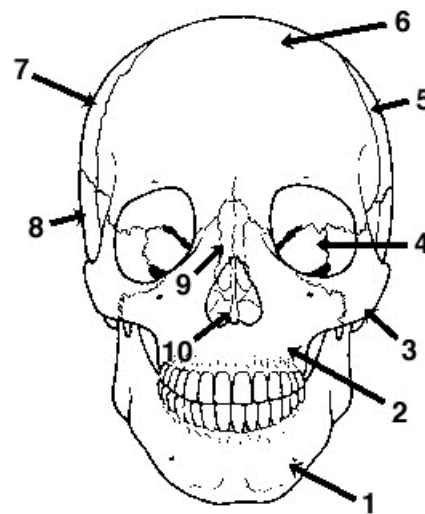
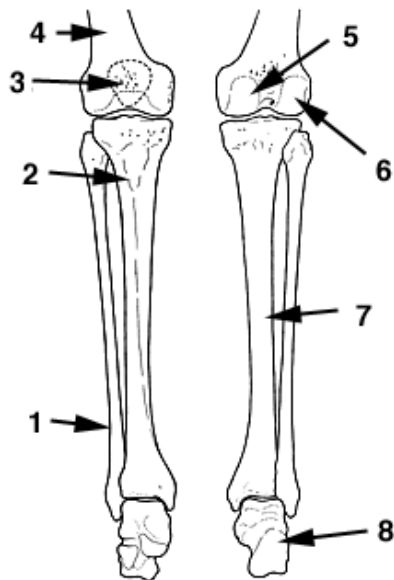
Use the following pictures for practicing for your bone practical exams! Label each and every bone and markings you can see in the following skeletons.

Posterior view of the human skeleton



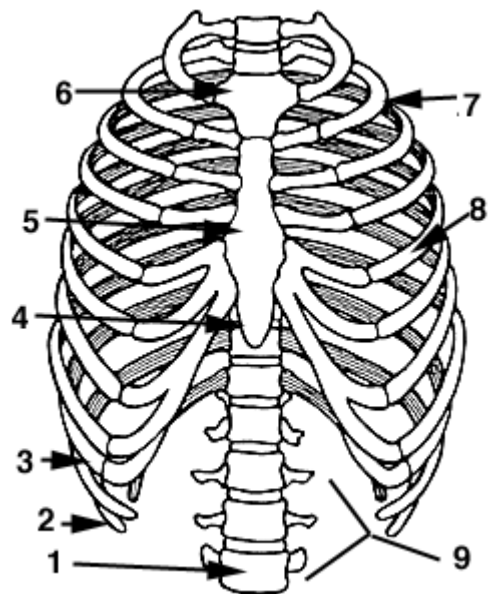
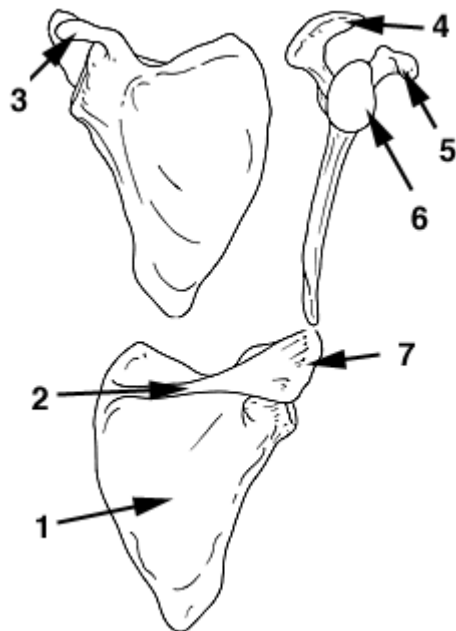
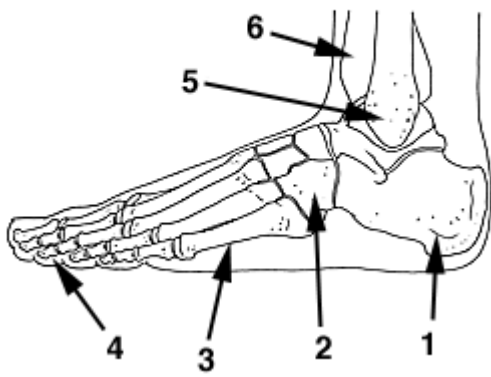
Review worksheet for the Bone Practical

Use the following pictures for practicing for your bone practical exams! Label each and every bone structure in the following structures.



Review Worksheet for the Bone Practical

Use the following pictures for practicing for your bone practical exams! Name the following structures and label each and every bone shown in them



BONE STUDY GUIDE -Bones you need to know for the practical exam

You must be able to identify them, know their number, location, and function in the skeleton; unique features, special movements caused by them, and their common names.

Vertebra and parts	Bones	Other terms/#
Atlas	Scapula	Head in femur and other bones
Axis	Clavicle	Neck in femur
Thoracic	Frontal	Trochanters in femur
Lumbar	Sternum	Acetabulum in coxa
Cervical	Manubrium	Obturator foramen in pelvis
Sacrum (5 fused bones)	Body of sternum	Male vs female pelvis
Coccyx (fused bones?)	Xiphoid process	Coracoid process of scapula
Body of each vertebra	Femur	Acromian process in scapula
Foramen in vertebra	Carpals	# of bones in skull
Spinous process	Patella	# of bones in face
# of vertebrae in V. column	Coxa	# of bones in hand
# of cervical vertebrae	Ilium	# of phalanges in skeleton
# of lumbar vertebrae	Pubis	Types of joints
# of thoracic vertebrae	Ischium	Ball and socket joint
Difference between atlas and axis	Humerus	Synovial/Hinge joint
Movements caused by atlas	Radius	Thoracic cage
Movements caused by axis	Rib	# of bones in Th. Cage
	Ulna	# of true, false, floating ribs
	Metacarpals	Male vs female pelvis
	Calcaneus	# of carpals/skeleton
	Maxilla	# of tarsals/skeleton
	Mandible	True rib
	Zygomatic	False rib
	Fibula	Floating rib
	Tibia	How many bones fused to make sacrum, coxa, sternum
	Occipital	Other bone markings covered in lectures/labs
	Talus	
	Metatarsals	
	Sutures in the skull	

The Muscles Online Activity



Part 1

Go to the following web site on your laptop computers. Click on “Muscles by region” and identify the location, origin, insertion, and action of each muscle listed below. Record all your data in the lab journal.

<http://www.meddean.luc.edu/lumen/MedEd/GrossAnatomy/dissector/mml/>

- ☺ Back: deltoid, latissimus dorsi, rhomboid major and minor, teres major, teres minor, trapezius
- ☺ Upper Limb: brachioradialis, deltoid, biceps brachii, triceps
- ☺ Head and Neck: buccinator, frontalis, masseter, platysma, sternocleidomastoid
- ☺ Thorax: diaphragm, intercostals external, pectoralis major
- ☺ Abdomen: external oblique, internal oblique, rectus abdominis, transverse abdominis
- ☺ Pelvis and Perineum: gluteus maximus, gluteus medius
- ☺ Lower Limb: biceps femoris, gastrocnemius, quadriceps femoris, rectus femoris, soleus, sartorius

Part 2

Go to the following web site and click on the “Muscular System”. Complete quizzes on the topics listed below:

http://www.gen.umn.edu/faculty_staff/jensen/1135/webanatomy/Images/default.html

- ☺ Anterior Muscles 1-10
- ☺ Posterior Muscles 1-9
- ☺ Muscle Physiology 1-2
- ☺ Muscle Simulation
- ☺ Sarcomere Anatomy 1-2

How Do Your Muscles Work?



INTRODUCTION:

Much of the work of the body depends on the contraction of skeletal muscles. In this experiment you will first observe the characteristics of muscle contraction and then will investigate the effects of two factors-temperature and fatigue on the action of your muscles.

MATERIALS: Dishpan of water, narrow strip of paper which will fit around upper arm, Ice or snow, Rubber ball or clothespin, Timer (clock, watch or stop watch).

PROCEDURE:

The following exercises will help you understand what happens to your muscles when they contract under different conditions.

Muscle Action

1. Place your fingers along the angle of your jaw just in front of your ear. Grit your teeth and observe what happens to the hardness of the muscles in your cheek.
2. With the thumb and little finger of one hand, span the opposite arm (front muscle of the upper arm) from the elbow to as close to the shoulder as possible. Bend the arm and observe the change in the length of the muscle. Do the same for the muscle of the inner arm as well. Compare the change of each muscle in length.

Effect of Temperature on Muscle Action

1. Count the number of times you can make a fist in 20 seconds. Start with your hand completely outstretched and make a tight fist each time. Do it as rapidly as you can. Record the count in Table.1
2. Now submerge your hand in a dishpan of ice cold water so that the temperature is near the freezing point. Leave your hand in water for one full minute.
3. Remove your hand and immediately count how many forceful fists you can make in 20 seconds.
4. Let your hand recover from the cold temperature shock. Submerge your hand in a dishpan of hot water (40°C). Leave your hand in water for one full minute.
3. Remove your hand and immediately count how many forceful fists you can make in 20 seconds.

Table. 1 Effect of Temperature on Muscle Action

Temperature	# of fists (each member)	# of fists (group average)
Normal room temp		
Ice water		
Hot water		

Effect of Fatigue on Muscle Action

1. Count how many times you can tightly squeeze a rubber ball in your hand in 20 seconds. (An alternative procedure which works well is to open and close a clothespin with the thumb and index finger while the other fingers are held out straight.) Record your data in Table 2.
2. Repeat the squeezing nine more times and record results. Do not rest between trials.

Table 2: Effect of Fatigue on Muscle Action

<u>Trial Number</u>	<u># of squeezes in 20 seconds (each member)</u>	<u># of squeezes in 20 seconds (group average)</u>
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

ANALYSIS OF DATA:

1. What are two changes you observed in a muscle while it is working (contracted)?
2. Skeletal muscles work in antagonistic pairs. What does that mean?
3. Make a line graph of your group results of the fatigue experiment. Be sure to fill in the values on the vertical axis (plot the trial number versus the number of squeezes and title your graph "the effect of fatigue on muscle action"). Label axes and use units!
4. What effect did fatigue have on the action of your hand muscles? Why? If your hand muscles did not show fatigue, why not?
5. What produces this muscle fatigue? Explain the process of muscle fatigue.
6. Compare the anaerobic process which produces muscle fatigue with the normal process of aerobic respiration which would occur in an unstressed hand use situation. Use equations and relative ATP yields in your explanation of this process.

Muscular System Test Study Guide

Structure of a muscle fiber, sliding mechanism of muscle, binding site of calcium and ATP during muscle contraction, threshold level, tetanus, depolarization, hyperpolarization, cardiac muscle, smooth muscle, skeletal muscle, synergists, antagonists, function of orbicularis oculi, characteristics of muscle fibers, deltoid muscle, muscle origin and insertion definition, gluteus maximus, gluteus medius, endomysium, epimysium, perimysium, insertion, origin, prime mover, breathing muscles, characteristics of skeletal muscle, muscle myofibrils: actin and myosin, sarcomere, resting membrane potential, role of ATP and creatine phosphate, definition: anaerobic respiration, muscles of mastication, muscular dystrophy definition, acetylcholine, motor unit, neuromuscular junction.

Human Muscles you must know for the test

#	Name	origin	Insertion
1	Orbicularis oculi	Maxilla and frontal bones	Encircles eye, inserts near origin
2	Orbicularis oris	Maxilla and mandible	Skin around the lips
3	Buccinator	Maxilla and mandible	Corner of the mouth
4	Temporalis	Temporal region on the side of head	mandible
5	Masseter	Zygomatic arch	Mandible
6	Sternocleidomastoid	Sternum and clavicle	Mastoid process of skull
7	Trapezius	Skull and upper vertebral column	Scapula
8	External intercostals	Ribs	Next rib below origin
9	Diaphragm	Interior of body wall	Central tendon of diaphragm
10	Rectus abdominis	Pubis	Rib cage and sternum
11	External abdominal oblique	Rib cage	Iliac crest and fascia of rectus abdominis
12	Pectoralis minor	Ribs	Coracoid process of scapula
13	Pectoralis major	Ribs and clavicle	Shaft of humerus
14	Teres major	Scapula	Humerus
15	Latissimus dorsi	Vertebrae	Shaft of humerus
16	Teres minor	Scapula	Greater tubercle of humerus
17	Deltoid	Scapula	Humerus

18	Triceps brachii	Humerus and scapula	Olecranon process of ulna
#	Name	origin	Insertion
19	Biceps brachii	Scapula; superior to glenoid fossa, and coracoid process	Radial tuberosity
20	Brachialis	Humerus	Coronoid process of ulna
21	Brachioradialis	Lateral epicondyle of humerus	Distal radius
22	Gluteus maximus	Ilium, sacrum, and coccyx	Lateral condyle of femur
23	Gluteus medius	Ilium	Greater trochanter of femur
24	Rectus femoris	Ilium	Tibial tuberosity via patellar tendon
25	Sartorius	Anterior superior iliac spine	Medial side of tibial tuberosity
26	Biceps femoris	Ischium and femur	Head of tibia
27	Semimembranous	Ischium	Medial condyle of tibia
28	Semitendinosus	Ischium	tibia
39	Gastrocnemius	Medial and lateral epicondyle of femur	Calcaneus
30	Soleus	Tibia and fibula	Calcaneus
31	Platysma	Fascia of deltoid and pectoralis major	Skin over inferior border of mandible
32	Zygomaticus major	Zygomatic bone	Angle of mouth
33	Rhomboideus major	Spinous process of T1-T4	Medial border of scapula
34	Supinator	Lateral epicondyle of humerus and coronoid process of ulna	radius
35	Flexor digitorum superficialis	Medial epicondyle of humerus, coronoid process, and radius	Middle phalanges of digits 2-5
36	Extensor digitorum	Lateral epicondyle of humerus	Extensor tendon expansion over phalanges over digits 2-5
37	Quadriceps femoris	Rectus femoris	Patella and tibial tuberosity, patellar ligament
38	Biceps femoris	Long head-ischial tuberosity	Head of fibula
39	Plantaris	femur	Through calcaneus tendon to calcaneus
40	Popliteus	Lateral femoral condyle	Posterior tibia