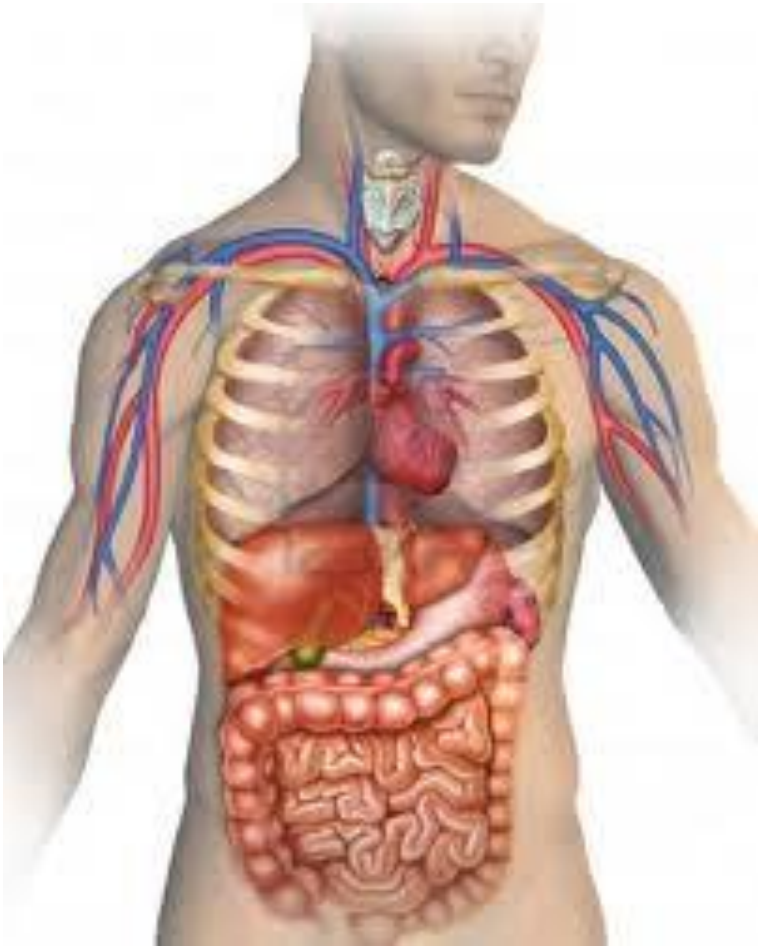
FORBUSH HIGH SCHOOL'S

Anatomy and Physiology Student Laboratory and Activities Manual

Learning, Understanding and Applying



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Rm 812J
(Fall 2015)

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Medical Terminology Prefixes

Prefix	Definition
A	No, not, without, apart
Ab	Away from
Ad	Toward, near
Ambi	Both
An	No, not, without, lack of
Ana	Up
Ant	Against
Ante	Before
Anti	Against
Apo	Separation
Astro	Star-shaped
Auto	Self
Bi	Two, double
Bin	Twice
Brachy	Short
Brady	Slow
Cac	Bad
Cata	Down
Centi	A hundred
Chromo	Color
Circum	Around
Con	With, together
Contra	Against
De	Down, away from
Deca	Ten
Di(a)	Through, between
Dif	Apart, free from, separate
Dipl	Double
Di(s)	Two, apart
Dys	Bad, difficult, painful
Ec	Out, outside, outer
Ecto	Out, outside, outer
Em	In
En	Within
End	Within, inner
Endo	Within, inner
Ep	Upon, over, above
Epi	Upon, over, above
Eso	Inward
Eu	Good, normal
Ex	Out, away from
Exo	Out, away from
Extra	Outside, beyond
Hemi	Half
Heter	Different
Hetero	Different
Homo	Similar, same
Homeo	Similar, likeness, constant
Hydr(o)	Water
Hyp	Below, deficient
Hyper	Above, beyond, excessive
Hypo	Below, under, deficient
In	In, into, not
Infra	Below
Infer	Below
Inter	Between

Prefix	Definition
Intra	Within
Ir(in)	Back
Macro	Large
Mal	Bad
Mega	Large, great
Meso	Middle
Meta	Beyond, over, between
Micro	Small
Milli	One-thousandth
Mon(o)	One
Multi	Many, much
Neo	New
Nulli	None
Olig(o)	Little, scanty
Pan	All
Par	Around, beside
Para	Beside, alongside, abnormal
Per	Through
Peri	Around
Poly	Many, much, excessive
Post	After, behind
Pre	Before
Primi	First
Pro	Before
Proto	First
Pseudo	False
Pyro	Fire
Quadri	Four
Quint	Five
Re	Back
Retro	Backward
Semi	Half
Sub	Below, under, beneath
Supra	Above, beyond
Super	Above, beyond
Sym	Together
Syn	Together, with
Tachy	Fast
Tetra	Four
Trans	Across
Tri	Three
Ultra	Beyond
Uni	One

MEDICAL TERMINOLOGY SUFFIXES

Suffix	Definition	Suffix	Definition	Suffix	Definition
-able	Capable	**-gnosis**	Knowledge	**-penia**	Lack of, deficiency
-ac	Pertaining to	**-grade**	A step	**-pepsia**	To digest
-ad	Pertaining to	**-graft**	Pencil, grafting knife	**-pexy**	Surgical fixation
-age	Related to	**-gram**	A weight, mark, record	**-phagia**	To eat
-al	Pertaining to	**-graph**	To write, record	**-phasia**	To speak
-algesia	Pain	**-graphy**	Recording	**-pheresis**	Removal
-algia	Pain	**-hexia**	Condition	**-phil(ia)**	Attraction
-ant	Forming	**-ia**	Condition	**-phobia**	Fear
-ar	Pertaining to	**-iasis**	Conditon	**-phoresis**	To carry
-ary	Pertaining to	**-ic**	Pertaining to	**-phragm**	A fence
-ase	Enzyme	**-ide**	Having particular quality	**-phraxis**	To obstruct
-asthenia	weakness	**-in**	Chemical, pertaining to	**-phylaxis**	Protection
-ate(d)	Use, action	**-ine**	Pertaining to	**-physis**	Growth
-betes	To go	**-ing**	Quality of	**-plakia**	Plate
-blast	Immature cell, germ cell	**-ion**	Process	**-plasia**	Formation, produce
-body	Body	**-ism**	Condition	**-plasm**	A thing formed, plasma
-cele	Hernia, tumor, swelling	**-ist**	One who specializes	**-plasty**	Surgical repair
-centesis	Surgical puncture	**-itis**	Inflammation	**-plegia**	Storke, paralysis
-ceps	Head	**-ity**	Condition	**-pnea**	Breathing
-cide	To kill	**-ive**	Nature of, quality of	**-poiesis**	Formation
-clasia	A breaking	**-kinesia**	Motion	**-praxia**	Action
-clave	A key	**-kinesis**	Motion	**-ptosis**	Prolapse, drooping
-cle	Small	**-lalia**	To talk	**-ptysis**	To spit, spitting
-clysis	Injection	**-lemma**	A sheath, rind	**-puncture**	To pierce
-cope	Strike	**-lepsy**	Seizure	**-rrhage**	To burst forth
-crit	To separate	**-lexia**	Diction	**-rrhagia**	To burst forth
-culture	Cultivation	**-liter**	Liter	**-rrhaphy**	Suture
-cusis	Hearing	**-lith**	Stone	**-rrhea**	Flow, discharge
-cuspid	Point	**-logy**	Study of	**-rrhexis**	Rupture
-cyesis	Pregnancy	**-lymph**	Clear fluid	**-scope**	Instrument
-cyst	Bladder	**-lysis**	Destruction, to separate	**-scopy**	To view, examine
-cyte	Cell	**-malacia**	Softening	**-sepsis**	Decay
-derma	Skin	**-mania**	Madness	**-sis**	Condition
-dermis	Skin	**-megaly**	Enlargement, large	**-some**	Body
-desis	Binding	**-meter**	Instrument to measure	**-spasm**	Tension, contraction
-dipsia	Thirst	**-metry**	Measurement	**-stalsis**	Contraction
-drome	A course	**-mnesia**	Memory	**-stasis**	Control, stopping
-dynia	Pain	**-morph**	Form, shape	**-staxis**	Dripping, trickling
-ectasia	Dilation	**-noia**	Mind	**-sthenia**	Strength
-ectasis	Dilation, distension	**-oid**	Resemble	**-stomy**	New opening
-ectasy	Dilation	**-ole**	Opening	**-systole**	Contraction
-ectomy	Surgical excision	**-oma**	Tumor	**-taxia**	Order
-edema	Swelling	**-omion**	Shoulder	**-therapy**	Treatment
-emesis	Vomiting	**-on**	Pertaining to	**-thermy**	Heat
-emia	Blood condition	**-one**	Hormone	**-tic**	Pertaining to
-er	Relating to, one who	**-opia**	Eye, vision	**-tome**	Instrument to cut
-ergy	Work	**-opsia**	Eye, vision	**-tomy**	Incision
-esthesia	Feeling	**-opsy**	To view	**-tone**	Tension
-form	Shape	**-or**	One who, a doer	**-tripsy**	Crushing
-fuge	To flee	**-ory**	Like, resemble	**-troph(y)**	Nourish, development
-gen	Formation, produce	**-orexia**	Appetite	**-type**	Type
-genes	Produce	**-ose**	Like	**-um**	Tissue
-genesis	Formation, produce	**-osis**	Condition	**-ure**	Process
-genic	Formation, produce	**-ous**	Pertaining to	**-uria**	Urine
-glia	Glue	**-paresis**	Weakness	**-us**	Pertaining to
-globin	Protein	**-pathy**	disease	**-y**	Condition, pertaining to

MEDICAL TERMINOLOGY ROOT WORDS

Root	Definition	Root	Definition	Root	Definition
Abdomin	Abdomen	**Bi/o**	Life	**Col/o**	Colon
Abort	To miscarry	**Blast/o**	Germ cell	**Colon/o**	Colon
Absorpt	To suck in	**Blephar/o**	Eyelid	**Cop/o**	Vagina
Acanth	A thorn	**Bol**	To cast, throw	**Concuss**	Shaken violenty
Acetabul	Vinegar, cup	**Brach/i**	Arm	**Condyle**	Knuckle
Acid	Acid	**Bronch/i/o**	bronchi	**Con/i**	Dust
Acoust	Hearing	**Bronchiol**	Bronchiole	**Conjunctiv**	To join together
Acr/o	Extremity, point	**Bucc**	Cheek	**Connect**	To bind together
Act	Acting	**Burs**	A pouch	**Constipat**	To press together
Actin	Ray	**Calc/i**	Lime, calcium	**Continence**	To hold
Aden/o	Gland	**Calcan/e**	Heel bone	**Cor/o**	Pupil
Adhes	Stuck to	**Capn**	Smoke	**Coriat**	Corium
Adip	Fat	**Capsul**	A little box	**Corne**	Cornea
Agglutinat	Clumping	**Carcin/o**	Cancer	**Corpor/e**	Body
Agon	Agony	**Card/i/o**	Heart	**Corti/c/s**	Cortex
Agor/a	Market place	**Carp/o**	Wrist	**Cost/o**	Rib
Albin	White	**Cartil**	Cartilage, gristle	**Cox**	Hip
Albumin	Protein	**Castr**	To prune	**Cran/i/o**	Skull
Alimentat	Nourishment	**Caud**	Tail	**Creat/in**	Flesh, creatine
All	Other	**Caus**	Heat	**Crin/e/o**	To secrete
Alveol	Small, hollow air sac	**Cavit**	Cavity	**Crur**	Leg
Ambyl	Dull	**Celi**	Abdomen, belly	**Cry/o**	Cold
Ambul	To walk	**Cellul**	Little cell	**Crypt**	Hidden
Amni/o	Amnion,sac around fetus	**Centr/i/o**	center	**Cubit**	Elbow, to lie
Amputat	To cut through	**Cephal/o**	Head	**Culd/o**	Cul-de-sac
Amyl	Starch	**Cept**	Receive	**Cutane/o**	Skin
Anastom	Opening	**Cerebell/o**	Little brain, cerebellum	**Cyan/o**	Blue
Andr/o	Man	**Cerebr/o**	Brain, cerebrum	**Cycl/o**	Ciliary body
Ang/i/o	Vessel	**Cervic**	Cervix, neck	**Cyst/o**	Bladder, sac
Angin	To choke, pain	**Cheil**	Lip	**Cyt/o**	Cell
Anis/o	Unequal	**Chem./o**	Chemical	**Cyth**	Cell
Ankyl	Stiffening, crooked	**Chlor/o**	Green	**Dacry**	Tear
An/o	Anus	**Chol//e**	Gall bladder, bile	**Dactyl/o**	Finger or toe
Anter/i	Toward the front	**Choledoch/o**	Common bile duct	**Defecat**	To remove dregs
Anthrac	Coal	**Chondr/o**	Cartilage	**Dem**	People
Aort/o	Aorta	**Chord**	Cord	**Dendr/o**	Tree
Append	Appendix	**Chori/o**	Chorion	**Dent/i**	Tooth
Arachn	Spider	**Choroid/o**	Choroids	**Derm/a/o**	Skin
Arche	Beginning	**Chromat**	Color	**Dermat/o**	Skin
Arter/i/o	Artery	**Chrom/o**	Color	**Dextr/o**	To the right
Arthr/o	Joint	**Chym**	Juice	**Diast**	To expand
Artific/i	Not natural	**Cine**	Motion	**Didym**	Testis
Aspirat	To draw in	**Cinemat/o**	Motion	**Digit**	Finger or toe
Atel/o	Imperfect	**Circulat**	Circluar	**Dilat**	To widen
Ather/o	Fatty substance	**Cirrh/o**	Orange-yellow	**Disk**	A disk
Atri/o	Atrium	**Cis**	To cut	**Dist**	Away from the origin
Aud/i/o	To hear	**Claudicat**	To limp	**Diverticul**	Diverticula
Auditor	Hearing	**Clavicul/o**	Little key	**Dors/i**	Backward
Aur/i	Ear	**Cleid/o**	Clavicle	**Duct**	To lead
Auscultat	Listen to	**Coagul/at**	To clot	**Duoden/o**	Duodenum
Aut/o	Self	**Coccyg/e/o**	Tail bone	**Dur/o**	Dura, hard
Axill/o	Armpit	**Cochle/o**	Land snail	**Dwarf**	Small
Bacter/i	Bacteria	**Coit**	a coming together	**Dynam**	Power
Balan/o	Glans penis	**Col/o**	Colon	**Ech/o**	Echo
Bas/o	Base	**Coll/a**	Glue	**Ectop**	Displaced
Bil/i	Bile, gall bladder	**Collis**	neck	**Eg/o**	I, self

LIVER ENZYMES AND REACTION RATES

Background: **Hydrogen peroxide** (H_2O_2) is a chemical that we all know to be used for treating wounds. It is an effective **antiseptic** because it is deadly to cells by causing the **lysis** of the **cell membrane**. Hydrogen peroxide is also produced as a waste product in living cells and must be quickly **denatured** before it can cause the membrane to rupture. An **enzyme** called ***catalase***, converts the unwanted peroxide into harmless oxygen gas (O_2) and water (H_2O). This reaction is accompanied by a release of energy which can be **quantitatively** measured.

Materials:

- 3 test tubes
- Test tube rack
- Liver sample
- Thermometer
- Graduated cylinder
- Tweezers
- Scissors
- Paper
- Pencil
- Stop watch

Procedures:

1) Place 5mL of H_2O_2 into a test tube.
2) Immerse the thermometer into the H_2O_2 and leave it for one minute. Record the starting temperature of the H_2O_2.
3) Place a bean sized piece of liver into the test tube and observe the reaction.
4) Leave the thermometer in the test tube and record the temperature changes every 30 seconds for six minutes.
5) Repeat the experiment two more times suing a clean test tube and fresh piece of liver.
6) Set up another three test tubes with 5mL of H_2O_2. This time, lacerate the liver several times and repeat the procedure.
7) Clean up the lab before you leave.

Analysis: Write up a lab report with the following sections:

1) **Introduction**-in which you describe what is taking place, what you will be doing as well as define all of the bold terms above.
2) **Methods and procedures-**where you describe step-by-step of what you did and what you used to do it with.
3) **Results-** in which you will create a graph of your results. The graph should contain the average temperature for the two trials only. Be sure to include a short paragraph of explanation below the graph.
4) **Conclusion and Analysis-**Write a conclusion paragraph in which you summarize the function of liver enzymes based upon your data. Be sure to include the type of reaction that took place. Also, include overall functions of the liver, which you can deduce based upon your results.

USING ANATOMICAL LANGUAGE

Forbush High School - Unit 1 Activity

Internet Activity

Background

"Anatomy is the foundation of medicine and should be based on the form of the human body." **Hippocrates**

http://www.skyscanner.net/news/x_ray_full.jpg

Anatomy is the study of the structures of the human body, while physiology is the study of the functions of these structures. A solid understanding of both is crucial for effective medicine and patient care. In addition to knowing anatomy & physiology, it is also important to be able to speak a common language among healthcare professionals. There are times that a physician, nurse, or therapist must document in medical records or communicate to other healthcare workers about the condition and/or treatment of a patient. In order to avoid confusion, standard anatomical terms are used to describe positions and reference points on the human body. This activity will be an introduction and review of common anatomical language used to describe relative positions, body sections, and body regions that communicate information about patients effectively in the healthcare field.

Materials

Computer
Internet Connection

Directions

Wisc-Online is an interactive resource with great modules to review anatomical terminology. Use the following links to review common anatomical language of which every healthcare professional should have a basic understanding. Answer the questions as you go through each module.

Anatomical Terminology: Relative Position
Go to the following site: http://www.wisc-online.com/objects/index_tj.asp?objID=AP15305
or use some other resource to answer the following:

1. Draw or define ***SUPERIOR*** **and** ***INFERIOR***. Give an example.

2. Draw or define ***ANTERIOR/VENTRAL*** **and** ***POSTERIOR/DORSAL***. Give an example.

3. Draw or define ***MEDIAL*** **and** ***LATERAL***. Give an example.

4. Draw or define ***PROXIMAL*** **and** ***DISTAL***. Give an example.

Body Sections and Divisions of the Abdominal Pelvic Cavity
Go to the following site: http://www.wisc-online.com/objects/index_tj.asp?objID=AP15605

5. What is the difference between **longitudinal, cross, transverse, and horizontal** cuts?

6. Draw a **SAGITTAL/MEDIAL** cut on Figure A below.
7. Draw a **CORONAL/FRONTAL** cut on Figure B below.
8. Draw a **TRANSVERSE/HORIZONTAL** cut on Figure C below.

Figure A

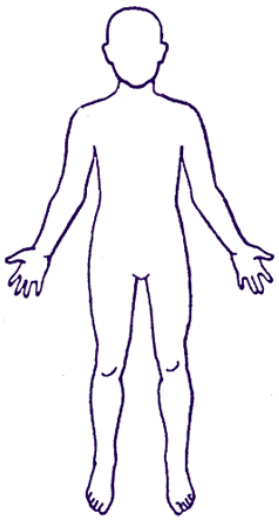


Figure B

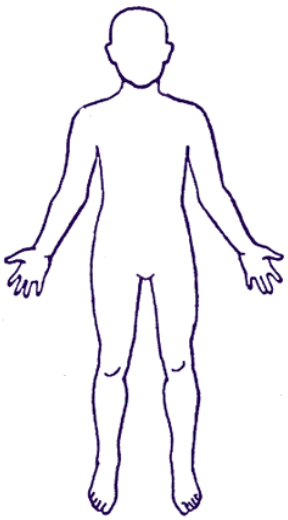
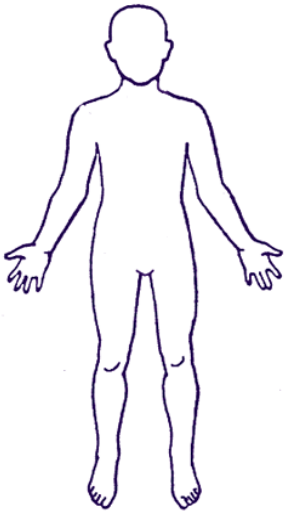


Figure C



9. Label the four **QUADRANTS** of the abdominal cavity on Figure D.

10. Label the nine **REGIONS** of the abdominal cavity on Figure E.

Figure D

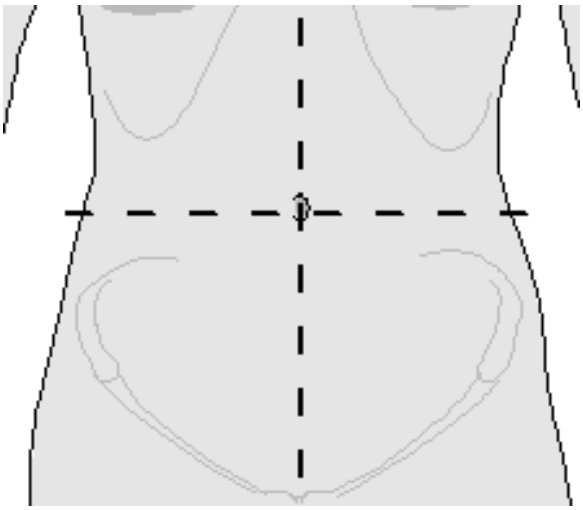
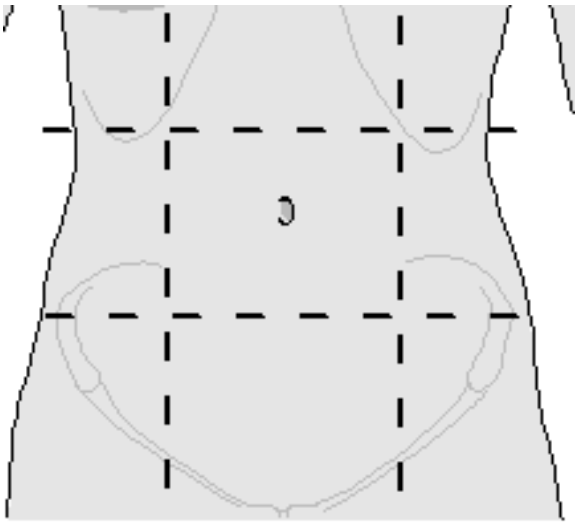


Figure E

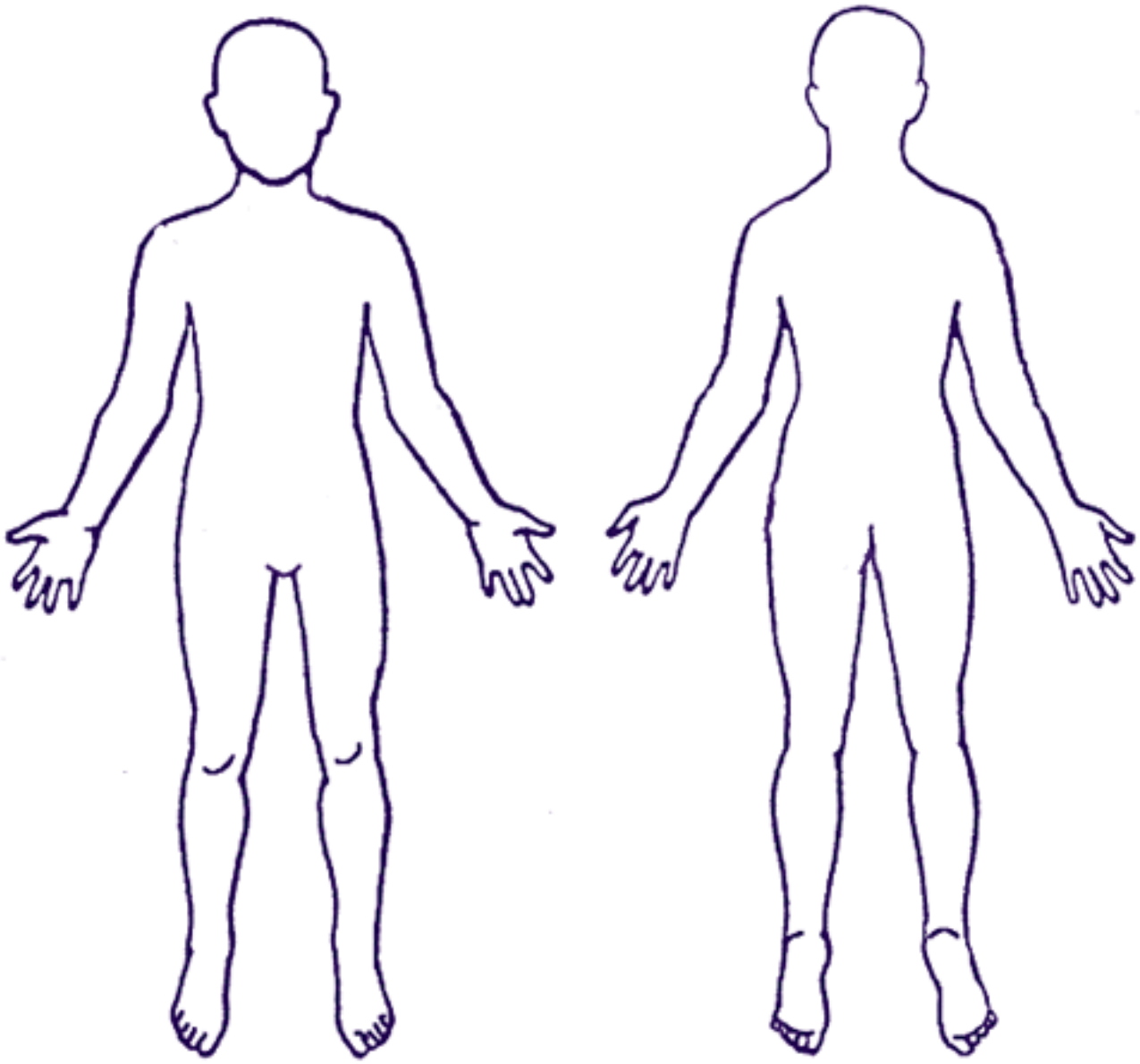


Regional Body Parts

Go to the following site: http://www.wisc-online.com/objects/index_tj.asp?objID=AP14904

Use the "*Review-Frontal*" and "*Review-Back*" to label Figure F with the anatomical terms. If it will help, use colored pencils to shade the area for each anatomical term. **There are 46 total**! Once you have completed the labeling, complete the "*Quiz-Frontal*" and "*Quiz-Back*". Star or highlight any of the anatomical terms that you had a difficult time remembering on **Figure F** below.

Figure F



Anatomical Terminology: Body Regions

Go to the following site: http://www.wisc-online.com/objects/index_tj.asp?objID=AP15405

Complete all of the drag-and-drop activities as review.

Analysis

Anatomical language is used throughout medicine, especially when describing a patient's disorder or disease. Use the information you have learned during this activity to answer the following.

Part A

Rewrite each statement using common language. The first one has been completed for you.

1. **The patient reported sharp inferior posterior cephalic pain extending into the cervical region and bilaterally into the brachial regions.**

ANSWER: The patient has sharp pain in the lower part of the back of the head that extends down the neck and into both upper arms.

2. **Patient has swelling at the left olecranon with acute pain extending distally to the dorsum.**

3. **The patient fell and is reporting deep pain in the pelvic region with numbness extending laterally to the femoral, sural, and crural regions.**

4. **Patient has inflammation in the left scapular region that extends laterally and superiorly to the contralateral acromial region.**

5. **Patient reported a sharp tearing sensation in the posterior calcaneal region while playing football. Pain extends proximally to the ipsilateral popliteal region.**

6. **A laceration is located superficially on the right thorax 1 inch lateral to the midsagittal plane.**

7. **Patient is experiencing local pain at the right medial tarsal region with numbness and pain radiating to the ipsilateral hallux region.**

8. **Patient has a contusion on the medial portion of the left antecubital region that extends proximally to the left axillary region.**

9. **Patient is experience chronic pain in the medial inferior abdominal region with sharp pain in the RLQ 4-5 inches lateral of the umbilicus region upon movement.**

10. **Patient complains of sudden severe pain that starts in the medial lumbar region and extends bilaterally to the gluteal and posterior femoral regions.**

Part B

Rewrite each statement using medical terminology. The first one has been completed for you.

11. Pain is located in the right palm and extends into the pinky and index finger.

ANSWER: Pain is located in the right palmar and extends into the medial digital region.

12. The patient fell and attempted to stop the fall with the right hand. Patient is now experiencing pain in the right wrist that extends up the right forearm to the elbow.

13. Patient has a headache with pain in the forehead, in between the eyes, and the sinuses.

14. Patient has a cut on the left leg that starts at the outside of the knee, moves over the outside of the thigh, and ends at the left hip bone.

15. Patient is complaining of pain in the lower back that shoots down both sides of the backside and continues down the back of both legs to the knee when bending over.

16. Patient was hit in the face with a basketball during practice and has pain in his nose and right eye that extends to his right cheek and chin. Patient also has a ringing sound in his right ear.

17. The patient landed on the left shoulder and has pain under the left shoulder blade that shoots into the neck and upper part of the spine.

18. Patient dislocated the right thumb and has pain radiating through the forearm to the elbow.

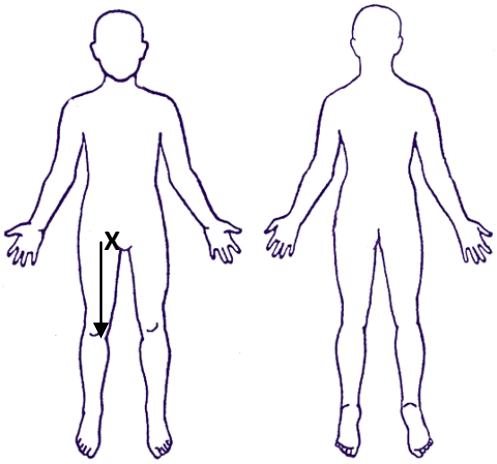
19. Patient is experiencing burning pain under the ribs and center of the chest that radiates into the upper back under both of the shoulder blades upon breathing.

20. Patient has located a large lump in the right breast a few inches to the outside of the nipple along with discomfort and swelling in the right armpit.

Part C

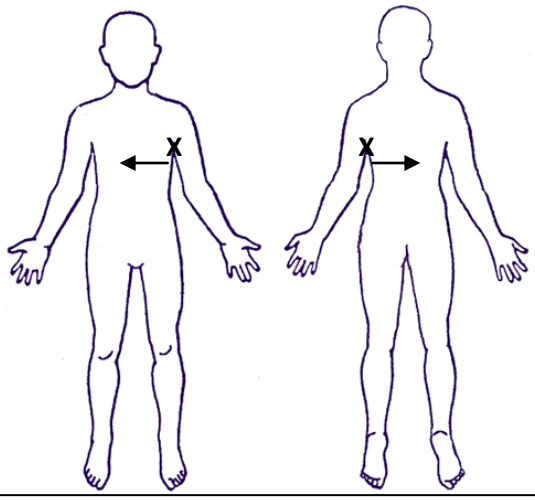
For each of the following diagrams write a statement in medical terminology describing the location of the pain. The X marks the area of pain, and arrows explain the direction any pain extends. The first one has been completed for you.

21.



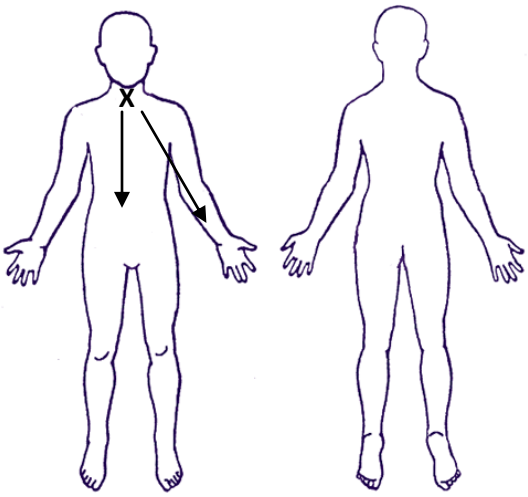
ANSWER: Pain in the right inguinal region extending down the lateral right femoral to the patellar region.

22.



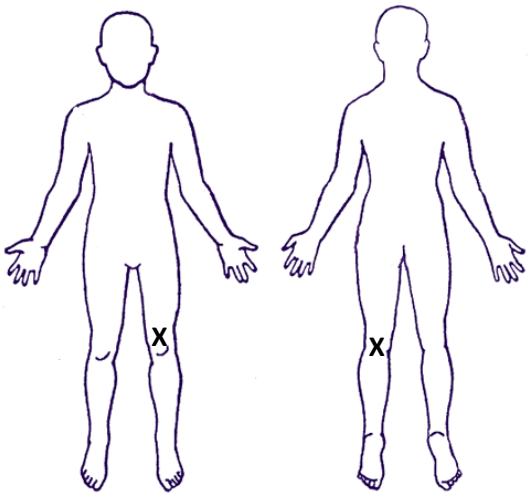
ANSWER:

23.



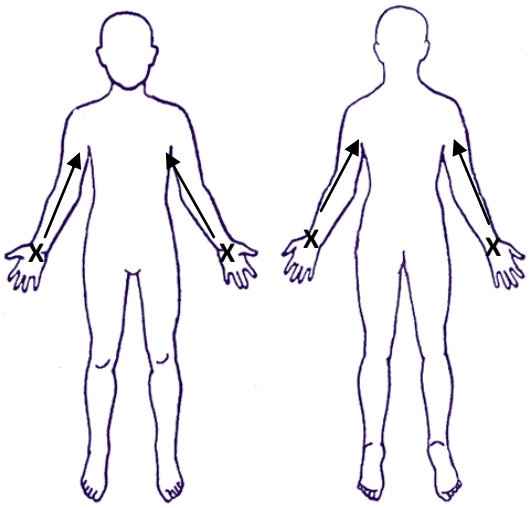
ANSWER:

24.



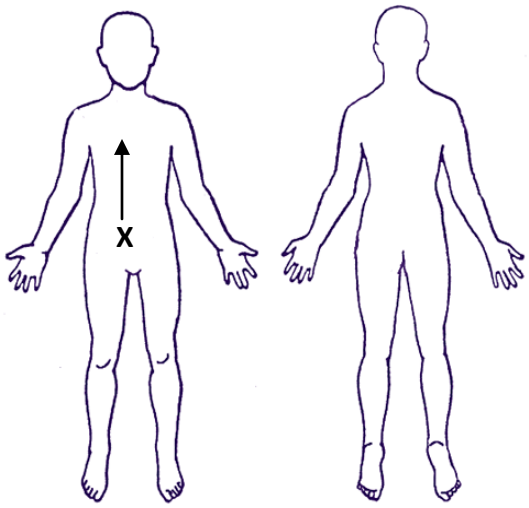
ANSWER:

25.



ANSWER:

26.



ANSWER:

IDENTIFICATION OF BIOMOLECULES

Introduction:

Our physical bodies are essentially a collection of common and exotic chemicals. Many of these chemicals are simple inorganic combinations such as sodium chloride, hydrochloric acid, molecular oxygen, and carbon dioxide. Most chemicals comprising our bodies are larger more complex organic molecules. The biochemical reactions that are occurring constantly within our cells synthesize new, larger molecules or decompose larger molecules into smaller pieces. **Anabolism** is a term used for all the synthesis reactions occurring at any time; **Catabolism** is a term that refers to all the decomposition reactions occurring at any time. **Metabolism** is a term that refers to ALL the reactions that might be occurring in the body. While our bodies can metabolize a wide variety of organic molecules, the vast majority belong to three major groups: **carbohydrates**, **lipids** and **proteins**.

Carbohydrates are composed of carbon, hydrogen and oxygen atoms in a ration of $(CH_2O)_n$ where ***n*** can be any number depending on the complexity of the carbohydrate. **Simple sugars** such as glucose and fructose are called **monosaccharides**. More complex carbohydrates such as starches are **polymers** of these monosaccharide units and are called **polysaccharides**. Simple carbohydrates are broken down or catabolized in a process called **glycolysis** which provides the cells with most of its energy.

Lipids, including fats and steroids are composed of carbon, hydrogen and oxygen atoms. They are important components of cell membranes and are used as hormones and for energy storage. Excess food is usually stored as fat in adipose tissue cells.

Proteins are constructed from long chains of amino acids and contain carbon, hydrogen, oxygen, nitrogen and sulfur atoms. Proteins provide the major structural components of our cells and therefore our bodies. Other proteins serve as **enzymes** which are the major catalysts that facilitate complex biochemical reactions in our cells We can perform simple tests to identify some of these molecules by adding indicators to a solution to be tested. A change in color or other physical characteristic indicates the presence or absence of a particular kind of organic molecule.

A. **Simple carbohydrates (sugars)**.
Benedicts solution causes some sugars to turn green, yellow, orange or red when heated to boiling. The color of a positive reaction depends on how much sugar is present (green indicates low levels; red high sugar levels).

B. **Complex carbohydrates (polysaccharides or starches)**.
Lugol's iodine causes a solution containing starch to turn dark blue to black. The more starch there is the darker the color.

C. **Lipids (fats and oils)**.
Large amounts of concentrated lipids leave a translucent stain on absorbent paper after drying.

D. **Proteins (and Polypeptides)**
Biuret solution causes a protein solution to turn pink or violet.

The first step in learning to detect these chemicals is to perform **control** tests with substances **known** to contain or not to contain specific chemicals. You will perform each of the above tests on a "positive" and a "negative" solution (the "negative" is usually water). After completing the tests you will see both the positive and negative results for each of the different kinds of molecule above. Then you can compare your experimental tests to the control results to see if each of the different kinds of organic molecules are present in each test solution.

Control Test Procedures:

1. Sugars:

a) take two clean test tubes and label one su+ and the other su-.
b) add about 1 cm of glucose solution (10% Karo) to su+
c) add about 1 cm of DI water to su-
d) add 5 drops of Benedict's solution to each test tube
e) place both test tubes in a boiling water bath at your table for about 2 minutes
f) record the reaction as either "+" or "-" in the table on your data sheet

2. Starches

a) add a drop of boiled starch solution (1% starch) to one of the wells in the spot plate and a drop of DI water to another well
b) add 1-3 drops of Lugol's iodine to each of the wells
c) record the reaction as either "+" or "-" in the table on your data sheet

3. Lipids

a) with a dropper add a drop of oil (vegetable oil) to one half of a paper towel
b) with another clean dropper add a drop of DI water to the other half of a paper towel
c) place the paper towel in the incubator on a warming tray for 5 minutes
d) record the reaction as either "+" or "-" in the table on your data sheet

4. Proteins

a. add a drop of protein solution to a clean spot plate
b. then add a drop of Biuret solution to the same well
c. add a drop of DI water to another well on the spot plate
d. then add a drop of Biuret solution to the same well
e. record each of the two reactions as either "+" or "-" in the table on your data sheet

Experimental Tests

In the second part of this exercise you will be testing each of the solutions that you are given by adding indicators to test for the above molecules. But before you actually perform the tests make predictions by noting which organic molecules you would expect to find in each of the solutions with a "+" sign in the "expected results" section of your data table. Place a "-" if you do not expect to find that kind of molecule.

Perform the tests on each of the solutions provided the same way you tested each control solution and record your results in the "experimental results" section of your table on your data sheet.

Use the spot plate for the starch tests; use a paper towel for the oil test; use test tubes for the benedicts and protein tests.

You will need to clean and rinse the test tubes in DI water and reuse them during this lab. At the end of the lab you can discard the test tubes in the glass disposal boxes.

Cleanup and Disposal

- Discard all solutions into the sink with the water running
- **Do NOT** empty water from beaker on hot plate
- Make sure the hot plate is turned off and unplugged before you leave; leave the beaker on the hot plate
- Dispose of empty test tubes in the glass disposal box
- Dispose of plastics and paper towels in trash
- Clean spot plates with soap and water and return it to your lab table
- Wipe down counters with disinfectant

Name:_____

Due Date:_____

Identification of Biomolecules

Lab Data Sheet

Control Tests: For each control test below record your results as a "**+**" or "**-**" in the column to the right.

Control Tests	Results +/-
Sugar Test	
Sugar Solution	
DI water	
Starch Test	
Starch Solution	
DI water	
Lipid Test	
Oil	
DI water	
Protein Test	
Protein Solution	
DI water	

1. Did all the control tests give the expected results, if not explain?

2. Why are these called "control" tests?

3. What would be the consequences for the rest of this experiment if any of the control tests did not produce the expected results? Describe a specific example.

Experimental Tests: Write out your 'hypothesis' being tested (your expected results) for each solution below and then record your experimental results as a "**+**" or "**-**" in the columns to the right.

Solution	Expected Results [+/-]					Experimental Results [+/-]			
	sugar	starch	lipid	protein		sugar	starch	lipid	protein
Apple Juice									
Diet Soda									
Oatmeal sol.									
Bottled Water									
Honey sol.									
Unknown #1									
Unknown #2									
Unknown #3									

Compose a paragraph for each of the unknowns that specifically explains how came to the identity of the unknown. It is not enough to say that "it is a protein", but you must explain the rationale that you used to make that determination.

Everything is to be turned in to Mr. Sewell when completed. The following should be included in the work you submit:

1) The control test results.
2) The answers to the 3 questions below the control tests.
3) The chart on the various biomolecules.
4) Based upon your data, which substances would be poor choices for sources of nutrition if you were on a strict anti-carbohydrate diet?
5) Based on the biochemical analysis and your own intuitive reasoning, try to make an identification of the three unknowns and justify your reasoning.

pH, CELL STRUCTURE, DIFFUSION & OSMOSIS

Anatomy and Physiology

This is your study guide for the lab work & any lab quizzes. You should know information provided in these notes and any additional information your instructor provides. Refer to any Human Physiology text for additional information or clarification of these notes. We will answer the review questions in lab as a team. In general you will be asked to provide answers to the review questions covering the experiments that you performed. These notes are NOT handed in for grading. The quiz on this topic may cover any material within these notes, including introductory information, experimental design and the review questions.

pH Effects in the Body

Acids increase the concentration of H^+. They typically release > 1 H^+. Some examples are:

- hydrochloric acid HCl ------> H^+ (hydrogen ion) + Cl^- (chloride ion)
- carbonic acid H_2CO_3 ------> H^+ + HCO_3^- (bicarbonate ion)
- acetic acid CH_3CHO_2 ------> H^+ + $CH_3CO_2^-$

Bases (alkaline substances) decrease the concentration of H^+ by binding to free H^+ they remove H^+ from solutions.

- (hydroxyl ion)OH^- + H^+ -----> H_2O
- sodium hydroxide NaOH readily ionizes in water NaOH ----> Na^+ (sodium ion) + OH^- (hydroxyl ion)

Water is both an acid and a base, if it ionizes. However, water ionizes rarely.

$$H_2O \text{ -----> } OH^- + H^+$$

The **pH scale** is a measure of the number of H^+ present in a solution. The symbol for H^+ concentration is $[H^+]$. pH is proportional to the inverse of the concentration of H^+ ~ $(1 / [H^+])$. Which of the substances described above are organic molecules? Recall that organic molecules must have Carbon (C) & Hydrogen (H) atoms.

- Normal plasma has a pH = 7.35 - 7.45 so it is slightly alkaline.
- Neutral pH = 7 of pure water releases an equal number of H^+ & OH^- ions
- Acidic pH < 7 means more H^+ are present or fewer OH^- ions are present
- Basic/Alkaline pH > 7 means fewer H^+ are released or more OH^- are present

The pH scale is log transformed, $pH = - \log[H^+]$. This means a 1 unit difference in value equals a 10X difference in the amount of hydrogen ions. Thus a pH of 3 is 10X more acidic than a pH of 4. A pH of 12 is 100X more alkaline than a pH = 10 because there is a 2 unit difference in the pH values, so it is a 10 X 10 = 100 difference in acidity.

A variety of homeostasis imbalance problems can lead to pH imbalances in the body's extracellular fluids (e.g. blood plasma pH). We will discuss more during the quarter, but digestive tract imbalances are relatively common & easily explained as follows:

Diarrhea or chronic use of laxatives causes the loss of alkaline fluids from the intestines. If this is severe or chronic, the blood pH becomes more acidic. An acidic shift (below the normal range) in plasma pH is called acidosis. **Acidosis** can inhibit activity of the brain & muscle tissues, which can lead to muscle weakness, fatigue, and finally a coma & death.

Vomiting caused by an illness or bulimia leads to loss of extremely acidic stomach fluids. Loss of acidic stomach fluid shifts your blood pH to a more alkaline range. Extreme alkaline shifts of blood plasma are referred to as alkalosis. This has the opposite effect on the brain & muscle tissue to acidosis. Severe alkalosis may trigger excessive muscle tension, a faster heart rate & ultimately convulsions & death.

Enzymes & other cellular proteins may begin to denature (unwind or lose normal shape) as a result of extreme shifts in extracellular pH (either acidosis or alkalosis). These changes result in the malfunction of many metabolic processes.

Introduction to the Cell Membrane

Cells are the basic building blocks of living systems. All living things are made up of cells and all cells come from preexisting cells. A watery environment that is called extracellular fluid surrounds cells. Examples of extracellular fluids include: **plasma** (the fluid portion of blood) and **interstitial fluid** (fluid that is in the small spaces or interstices that surround most cells).

Most animal cells are very similar in design. The outer surface of a cell is called the cell or plasma membrane. The cell or plasma membrane is made up primarily of phospholipids so that it is selectively permeable or semi-permeable. Most lipids or **non-polar** (uncharged) substances move easily through a cell membrane. An exception is water. Water is an extremely small molecule, in very high concentrations in all body fluids. There are almost always small water channels in the membrane that allow water to move freely into or out of a cell. Most **polar** (charged, or ionic) substances move more slowly than water if they move at all across a cell membrane, in part because they are not as numerous as water molecules. Some polar molecules require active transport (which includes the expenditure of cellular ATP & the presence of special carrier proteins) to enter or leave a cell. Substances that move via active transport move more slowly than water across a cell membrane, because carriers have “rate limits” or maximum speeds at which they function. Some polar molecules may not move at all if the necessary carriers are missing from that cell membrane.

Some cells increase the amount of membrane by forming a dense series of finger-like projections called **microvilli** on one side of a cell. Microvilli increase the rate of transport across the cell membrane by increasing the surface area of the cell.

The internal environment of a cell is called **cytoplasm**. Cytoplasm contains **intracellular fluid** & organelles such as the nucleus and mitochondria. Intracellular fluid is highly viscous (sticky).

Experiments: pH Testing

One or two groups of students will measure the pH of some common substances.

First test each substance with a broad scale pH paper.

- These strips have a series of color bars that can be matched to standards on the box.
- The paper will indicate integer values from 0-14.

Second, if materials are available, test each substance with an appropriate more narrowly defined pH paper scaled to 1 decimal place.

- For example, if a substance had a pH = 6 on the broad scale paper, use the narrow range paper for values between 5 & 7.
- Record this more accurate value. For example the solution may have a pH = 6.4.

Was this substance acidic, basic or "relatively" close to neutral (>6.5 but < 7.5)?

Check the results with your classmates' data and with your instructor. Be sure your values are in the correct range.

Your group will answer the review questions on pH for the entire class.

Solution	**Broad Range pH**	**Acidic, Basic or Neutral**
tap water		
Pepsi or Coca Cola		
Vinegar		
coffee		
bleach (1:10 dilution)		
apple juice		
baking soda		
tomato juice		
Milk of Magnesia		
lemon juice		
egg white		
liquid soap		

Diffusion Experiments

All molecules are in constant motion. As molecules bump into each other, directions are changed, causing random dispersal of the molecules. The random movement of molecules results in diffusion. Diffusion occurs when molecules of substance X move away from an area or source of higher concentration towards an area of lower concentration of substance X. Molecules of substance X move away from the area of higher concentration because the molecules encounter fewer obstructing molecules in the area of lower concentration. The rate of diffusion is variable and depends on temperature, molecular weight, distance to travel, solvent density, and other factors.

In your experiment, we are using an agar or gelatin gel. Agar is a gel extracted from a type of red seaweed found along the Pacific coast. The methylene blue dye has a Molecular Wt. = 320, and thus is a very heavy molecule. Your experiments & information from the web links should help you understand the effect of molecular weight, concentration and temperature on diffusion.

Directions for making the agar plates:

The formula for the agar plates is 1.5g of agar in 100 ml of water, so this is a 1.5% agar solution.

1. Measure out 1.5g of agar using a balance of your choice.
2. While one person is measuring out the agar, another person should begin to heat 100 ml of water on a hot plate.
3. Slowly add the agar to the hot water and continue to stir the mixture to break up any large, clumping particles.
4. When the mixture is completely dissolved, slowly pour into a Petri dish. Be careful to not pour to quickly as this will cause air bubbles to form.
5. When each plate is approximately ¾ full, place them aside on a paper towel with your name on them. It usually takes about 30-40 min for the agar to set up.

WARNINGS

The methylene blue dye should not come in contact with your skin or clothes!

Wear latex or vinyl gloves while handling the dye solutions.

- Place paper towels on the table beneath your agar plates while they are filled.
- Obtain 2 Petri dishes prepared with agar &/or gelatin.
- Use a straw to remove 2 disks of agar or gelatin from each plate.
- Keep your holes away from the edge of the plate & at least 2 cm apart from each other.
- The holes should be cleanly cut, no nicks or cuts. If not, cut a new hole.
- Check afterwards to be sure the agar remains firmly stuck to the bottom of the dish.

Procedures

1. Fill 1 well on each of your plates with the 0.01M methylene blue dye.
2. Fill the other well on each plate with the 0.001M methylene blue dye.
3. Use the micropipettes to fill each well without spilling dye on the surface of the agar.
4. Be sure ALL wells are filled to the SAME height (nearly to the top of the agar).
5. Use a grease pencil to mark the Petri dish so that you will know which solution is used in each well.

- When both agar plates are ready, place 1 plate on a heating pad & 1 plate on ice.
- Leave the plates in position for 20-30 min., but measure all plates after the same time interval.
- Measure the maximum spread of dye from each well by measuring the outermost diameter of each dyed circle in mm, by placing a sheet of white paper under the Petri dish & then placing the ruler underneath the dish.
- After you have measured the dye wells, save your agar plates so the rest of the class can see your samples.
- Your group will answer the review questions on diffusion for the entire class.

Place your information in the following table:

DYE CONCENTRATION	**Max. Diameter (mm) Cold Agar**	**Max. Diameter (mm) Cold Agar**	**Max. Diameter (mm) Hot Agar**	**Max. Diameter (mm) Hot Agar**
Methylene Blue Dye Conc.	**0.010M**	**0.001M**	**0.010M**	**0.001M**
Trial 1				
Trial 2				

Osmosis Experiments

Water is a charged or polar molecule ($H^+ - O^- - H^+$) that is always moving across cell membranes. Scientists theorize that this is possible because it is such a small molecule or because there are special gap or pores that allow water movement through the cell membrane. The predominant direction of water flow is determined by the concentration of the solutes (non-water molecules) inside and outside of the cell. Water molecules will show a new movement from an area of higher water concentration (& lower in solutes) to an area of lower water concentration (& higher in solutes). In other words the net water flow tends to dilute an area of higher solute concentration. When water moves by diffusion through a semi-permeable membrane it is called osmosis. This is a type of passive transport because no cellular energy (ATP) is involved in the movement of water.

For convenience we will use tonicity & osmolarity as interchangeable terms. In fact, there are exceptions when these terms do not have identical meaning. An extracellular solution is isotonic ["iso" = same, tonicity = tone or tension] or iso-osmotic to a cell if the cell has no net gain or loss of water. This is a dynamic equilibrium. The cell & the extracellular solution have the same concentration of water & the same concentration of solutes. Our extracellular fluids need to stay isotonic in order for cells to survive. Iso-osmotic solutions can be used as intravenous solutions or during kidney dialysis because they maintain the osmotic balance of the body's extracellular fluids.

If cells are placed in a solution that contains a higher concentration of solutes than the cell, cells suffer a net loss of water and appear crenated ["cren" = notched] or wrinkled. These cells are in a hypertonic or hyperosmotic solution. Cells in a highly hypertonic solution may die from this **dehydration**.

A solution that has a lower solute concentration than is present in cells is said to be a hypotonic or hypo-osmotic solution. In this case, excess water flows into the cells and the cells swell. Neurons begin to malfunction when **overhydrated**. Blood cells & other cells may eventually rupture or burst open in a process called **lysis**.

Although we simplify osmolarity problems by using the % of a solute to represent its concentration, two solutions with the same % of solutes may NOT have the same number of solutes. Accurate osmolarity calculations must use a more complex calculation as follows:

All molar solutions contain the same number of molecules:

- 1 mole unit of any molecule has 6.02×10^{23} molecules in 1 liter of solution.
- 1 mole of a substance equals its molecular wt.

Osmolarity is calculated as (n) x moles, where **n** = the number of dissociated particles that are present when a substance is placed in water. 1 mole of glucose has an osmolarity = 1 Osmole because glucose doesn't ionize in water. 1 mole of sodium chloride has an osmolarity = 2 Osmoles because it ionizes freely into two ions: Na^+ and Cl^- when placed in water.

0.30 Osmoles of any solute is isotonic with a normal plant or animal cell.

Be able to calculate the grams needed of a molecule to make an isotonic solution if you are given the molecular weight of a molecule & the number of particles into which it ionizes, as shown below:

Example #1

- Sodium chloride (NaCl): molecular weight = 58.5 g (Add the mass numbers)
- 1 mole of sodium chloride (NaCl) = 58.5 g NaCl / 1000 ml water
- Sodium chloride readily ionizes into Na^+ and Cl^- so its osmolarity is 1/2 X its molarity.
- Isotonic NaCl = 0.30 osmoles of NaCl / 2 particles = 0.15 moles of NaCl
- 0.15 moles of NaCl = 58.5g NaCl/1000 ml water (1 mole NaCl) * 0.15 = 8.8 g NaCl / 1000 ml
- 8.8 g NaCl / 1000 ml water = 0.88 g NaCl/100 ml water = 0.88% NaCl solution
- **An isotonic NaCl solution has 0.88% NaCl**

Example #2

- Glucose ($C_6H_{12}O_6$): molecular weight = 180 g
- 1 mole of glucose = 180.0 g $C_6H_{12}O_6$ / 1000 ml water
- Glucose rarely ionizes in water, so its osmolarity is 1 * its molarity.
- Isotonic Glucose = 0.30 osmoles of glucose /1 particle = 0.30 moles of glucose
- 0.30 moles of glucose = 180 g glucose/1000 ml water * 0.30 = 54 g glucose/1000 ml water
- 54 g glucose/1000 ml water = 5.4 g glucose/ 100 ml water = 5.4 % glucose solution
- **An isotonic glucose solution has 5.40% glucose.**

Experimental Procedure - Using Potato Sticks

You will be given 5 potato sticks that are 4-6 cm long with a 1 cm diameter.

You will be provided with 5 vials each with a different salt or sugar solution.

1. Determine the initial mass (in g) of each potato stick. Your instructor will demonstrate how the balance is used.
2. Record this initial potato mass to 2 decimal places, for example: 3.15 g.
3. Immediately after each potato stick is massed, place it in one of the solution vials.

Predict which solutions **SHOULD BE** iso-osmotic, hyper-osmotic or hypo-osmotic to potato cells.

- **Clue:** We identified which solutions should be isotonic earlier in your notes.

Predict which solutions will cause the potato stick to gain or lose water & which solutions won't change.

THEN rank them by relative gain or loss:

0 = no change, +1 minimal gain, +2 moderate gain, +3 maximum gain

-1 minimal loss, -2 moderate loss, -3 maximum loss

- **Predict** (relatively) how much water potatoes will gain or lose in those solutions.

4. After 20 minutes mass each potato stick again & record the data.
5. Calculate the change in mass: final mass - initial mass = + or - change in mass.
6. Calculate the + or - %change as [change in mass (g) / initial mass (g)] X 100

Use the following tables to record your information.

Salt Conc.	INITIAL WT. of Potato	FINAL WT. of Potato	CHANGE IN WEIGHT (g) (show + or -)	CHANGE IN WEIGHT % (show + or -)	PREDICTED TONICITY RELATIVE TO LIVING CELL	RANK RELATIVE WATER LOSS OR GAIN
10% NaCl						
3.5% NaCl						
0.88% NaCl						
0.50% NaCl						
water						

Glucose Conc.	INITIAL WT. of Potato	FINAL WT. of Potato	CHANGE IN WEIGHT (g) (show + or -)	CHANGE IN WEIGHT % (show + or -)	PREDICTED TONICITY RELATIVE TO LIVING CELL	RANK RELATIVE WATER LOSS OR GAIN
30% Glucose						
10% Glucose						
5.4% Glucose						
3.5% Glucose						
water						

REVIEW QUESTIONS: Answer the questions by typing in your response under the questions. Make sure you bold or highlight your answers.

pH

1. Explain the relative acidity of a pH = 5 vs. a pH = 7.

2. Give 2 reasons why the water sample you tested did NOT have a pH = 7.

a.

b.

3. Describe 1 event that may cause your extracellular fluid to become too acidic.

4. What physical symptoms do you suffer from when your body becomes too acidic (i.e. you suffer acidosis?

5. Describe 1 event that may cause your extracellular fluid to become more alkaline.

6. What physical symptoms do you suffer from when your body becomes too alkaline (i.e. when you suffer alkalosis)?

7. How can you correct these pH imbalances? (We'll discuss the homeostatic regulation of pH later, so answer here what you might eat or drink to fix the problem).

a. acidosis

b. alkalosis

Diffusion

8. Describe 2 practical problems that can lead to measurement errors in the diffusion experiments.

9. Why should methylene blue travel farther in the agar if the dye concentration is higher?

10. Why should methylene blue travel farther under hot conditions?

11. Hypothesize what would happen if you used a lighter molecular weight dye.

Osmosis

12. Molecule X ionizes into 3 particles when it is placed in water, while substance Y does not ionize. If you are given solutions of molecule X & of molecule Y, each with a 0.2 molarity, what is the osmolarity of solution X & the osmolarity of Y? Show your work.

13. Which salt & glucose solutions should have been isotonic? Which hypertonic? Which hypotonic? Define these terms.

14. Potato slices in isotonic solutions should not show any weight change. Explain 2 practical measurement problems that could cause these potato slices to show a weight change.

15. Why do cells placed in hypertonic solutions lose water? How does the diffusion of water relate to solution tonicity?

16. Why do cells placed in hypotonic solutions gain water? How does the diffusion of water relate to solution tonicity?

17. Did the potato cells placed in more extremely hyper- or hypo-tonic solutions gain/lose even more water than less extreme solutions? Explain why they should or should not do this.

18. Explain how dehydration affects your body.

19. Explain how over-hydration affects your body.

A&P SLIDES: **TISSUES TO MUSCLES** Marty Sewell **Anatomy and Physiology Instructor** **Forbush High School** Rm 812J	**These are the tissues that you will be required to know for your histology examination.**	This is a "hyperlinked" document…Click on the slide name to see an image of the tissue.

Slide number	**Description of specimen**	**specimen source**
_____ 1.	**letter "e"**	photographic image
_____ 2.	**simple squamous epithelium**	frog mesothelium
_____ 3.	**simple cuboid epithelium**	rabbit kidney
_____ 4.	**simple columnar epithelium**	*Necturus* sm.intest.
_____ 5.	**stratified squamous epithelium**	dog esophagus
_____ 6.	**pseudostratified ciliated columnar epithelium**	trachea
_____ 7.	**areolar connective tissue**	cat subcutaneous
_____ 8.	**adipose connective tissue**	fatty tissue
_____ 9.	**white fibrous connective tissue**	tendon, c.s & l.s.
_____ 10.	**yellow elastic connective tissue**	cow nuchal lig.
_____ 11.	**hyaline cartilage**	trachea
_____ 12.	**elastic cartilage**	ear, elastic fibers
_____ 13.	**fibrocartilage**	intervert. disc
_____ 14.	**bone, ground**	human, c.s. compact
_____ 15.	**skin, mammal**	pig, c.s. follicles
_____ 16.	**smooth muscle**	frog, teased out
_____ 17.	**skeletal muscle**	striated muscle, l.s.
_____ 18.	**cardiac muscle**	heart
_____ 19.	**intercalated discs**	heart

Histology Review:

Directions: Complete the chart by filling in the missing information.

TISSUE TYPES		
MAJOR TISSUE	**SPECIFIC TYPES OF TISSUE**	**WHERE ITS FOUND IN YOUR BODY**
		Lining of air sacs in the lungs
	SIMPLE CUBOIDAL	
		Digestive tract (intestinal wall)
		Air passages (trachea, etc)
		Outer layer of skin
	TRANSITIONAL	
CONNECTIVE TISSUE		Binds skin to internal organs
		Layer beneath the skin
	FIBROUS CONNECTIVE TISSUE	
		Covers ends of bones at joints
	ELASTIC CARTILAGE	
	FIBROCARTILAGE	
		Skeleton
		Circulates throughout body
	RETICULOENDOTHELIAL	
		Muscles connected to bones
		Walls of many internal organs
		Walls of the heart
NERVE TISSUE	NERVE TISSUE	

A&P Case Studies in BioChemistry

Sweetness!

"Dear Lord!" exclaimed the nurse as she read off the patients lab report. Get the Doctor immediately she blurts out panickedly!

Your cell phone goes off. You dial the number. "This is Doctor (your name here) and I just got a page." You listen to the nurse. "Oh really! I'll be right there!"

When you arrive at the nurses' station she hands you the report. You immediately look over the numbers and rush towards the patient's room. You burst in to find Mr. Sewell, calmly resting in his bed, watching the ballgame on ESPN. A quick battery of evaluations leads you to the conclusion that Mr. Sewell is not in any distress. So you look at the lab report again.

Na	K	Cl	CO^2	O^2
212	9.8	90	35	97
mEq/L	mEq/L	mEq/L	mm Hg	mm Hg

Uric Acid	Creatine(CK)	Glucose	pH	Hematocrit
7.7	92	900	7.4	58%
mg/dL	units/L	mg/dL		

This blood report was just taken this morning. As a matter of fact, you had drawn the blood when you checked up on him this morning on your way to another surgery. You were in a hurry and didn't spend much time with Mr. Sewell, but he had seemed to be doing fine. He had wanted to know if he could get the IV out today. Said he was tired of his left arm being used for a pincushion. But otherwise he was in good spirits.

Mr. Sewell had a cholecystectomy just yesterday.

1) What is abnormal about the report?

2) Can these readings be explained physiologically?

3) What should you do next?

Use the values at www.bloodbook.com/ranges.html to determine values.

INTEGUMENTARY SYSTEM: A CASE OF SUNBURN

A Painful Winter Break:

On the first day after arriving in Australia for Christmas vacation, a Niagaran plays out in the sun for six hours. Later that night he notices that the skin on his legs and arms becomes red, swollen and extremely painful. By morning all of the afflicted areas have developed numerous blisters. These areas cover about 30% of his trunk (front and back) and 40% of the arms and legs.

1. What organ has been damaged?

2. What general types of tissue have been afflicted?

3. What type of burn has the student received? Explain.

4. What type of radiation has caused the burn?

5. List ALL layers of the skin that have been damaged:

6. List ALL the layers of the skin that have been killed:

7. What tissue repair process causes the blistering?

8. Why is this type of burn so painful?

A burn is considered critical and should receive prompt medical attention if:

- 25% of the body is covered by 2nd degree burns

or

- 10% of the body is covered by 3rd degree burns.

9. What percentage of the total body surface has been burned? Show your calculations.

10. Is the burn critical? Should the student seek medical attention?

11. List all the body's functions that might be disrupted by such a burn.

Recovery:

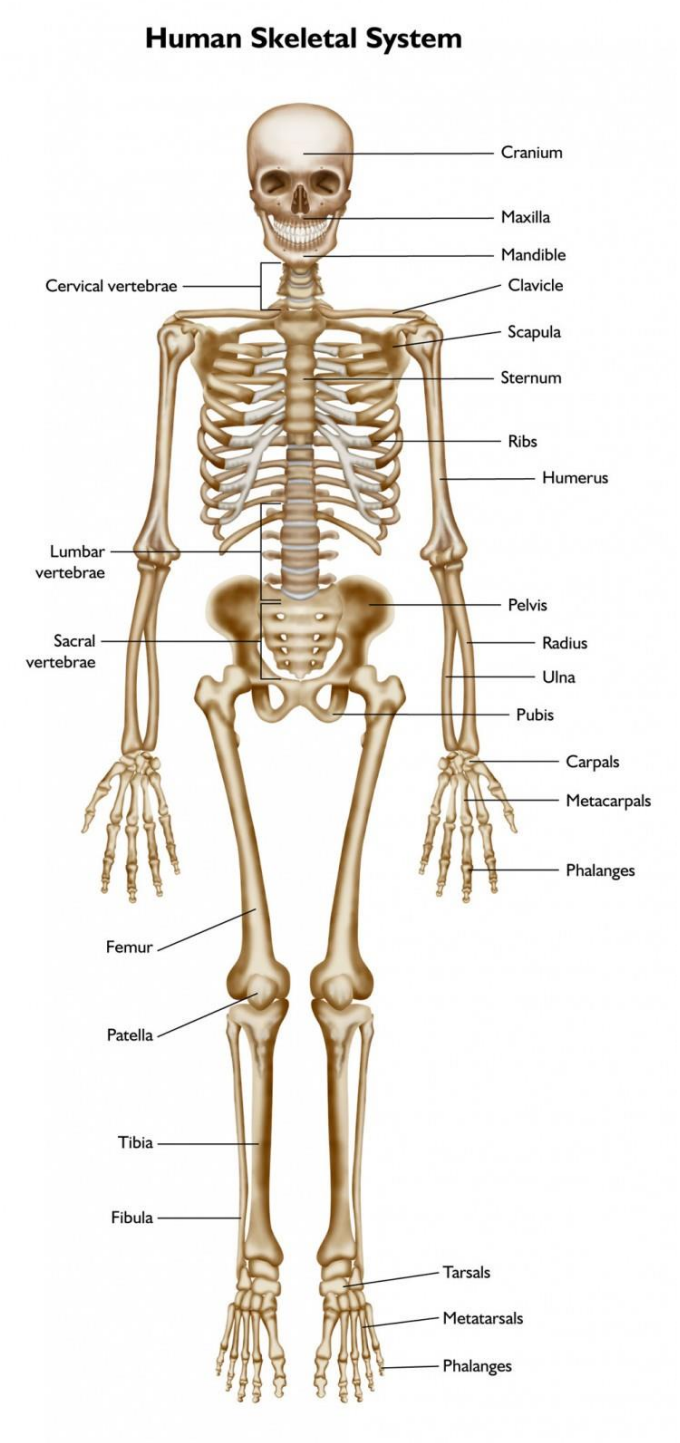
12. After a few days, the skin peels and the burned areas begin to heal. The student notices that the healing areas are more susceptible to injuries due to chafing. What has happened to the skin that would cause this increased susceptibility?

During the next week after the student returns to the States, his friend tells him that a sunburn prepares his skin for a deep tan. His friend encourages him to quickly get some tanning sessions at a local tanning salon before the effects of the sunburn wear off.

13. What would you advise him to do? Why?

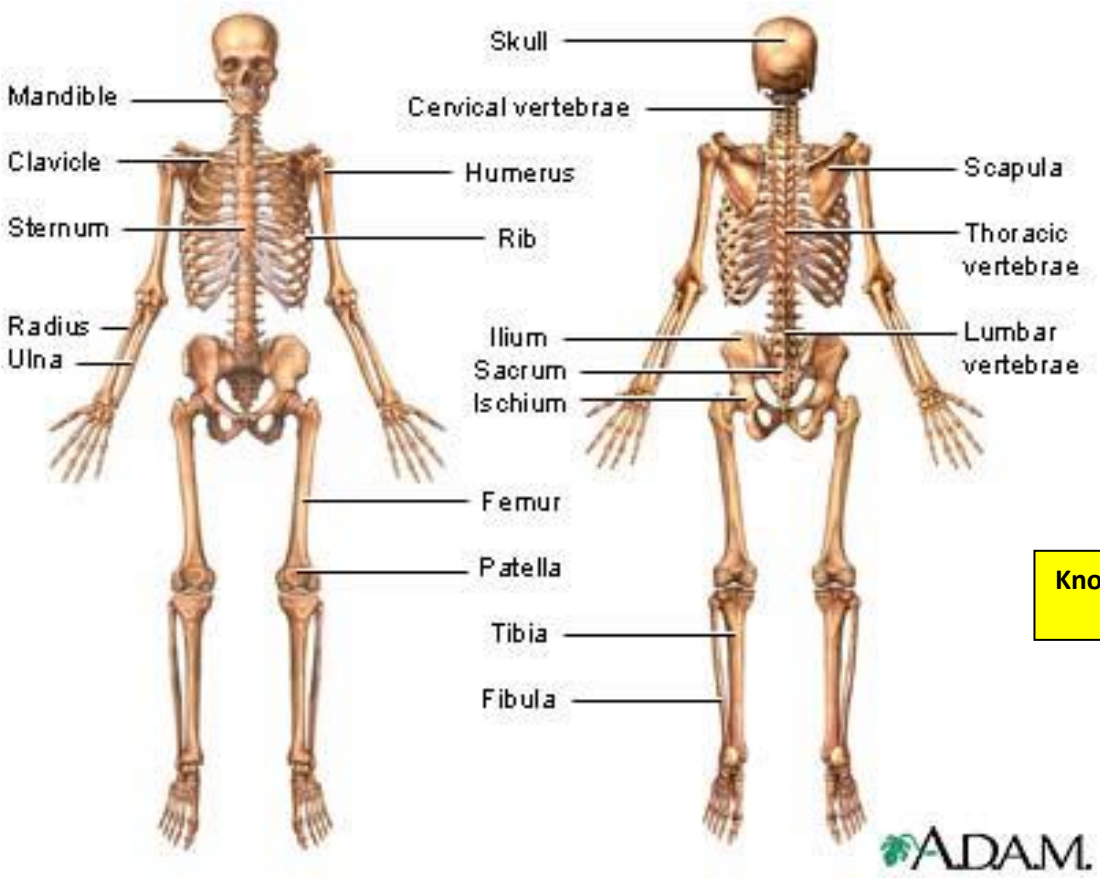
14. Is a deep tan a sign of skin that is healthy or severely stressed? Explain.

BONES AND PROCESSES NEEDED TO KNOW FOR ANATOMY:



Know all of these.

Be able label anterior and posterior views of the skeleton:

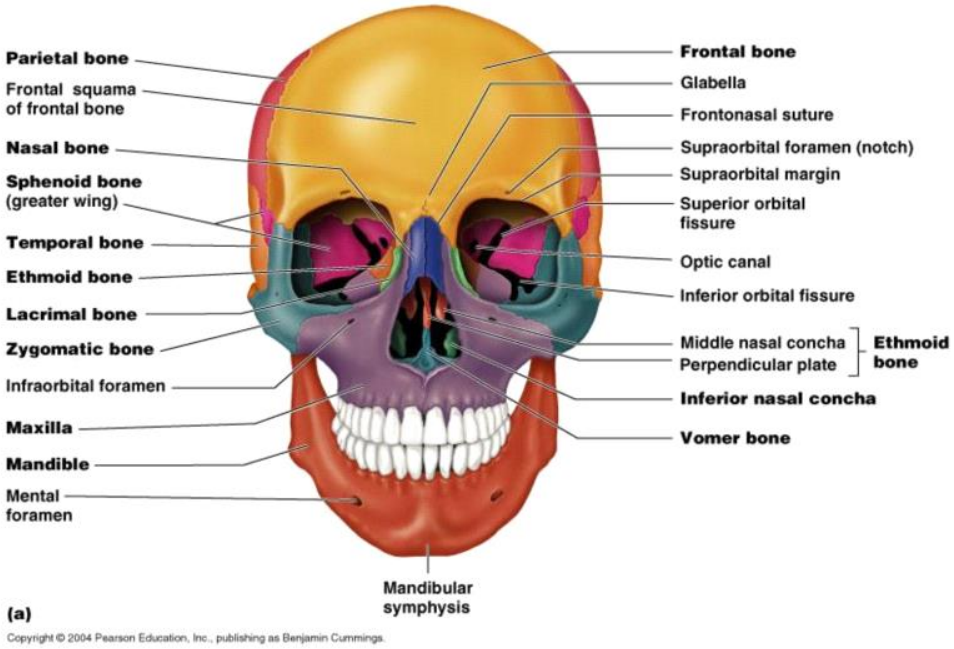


Know all of these.

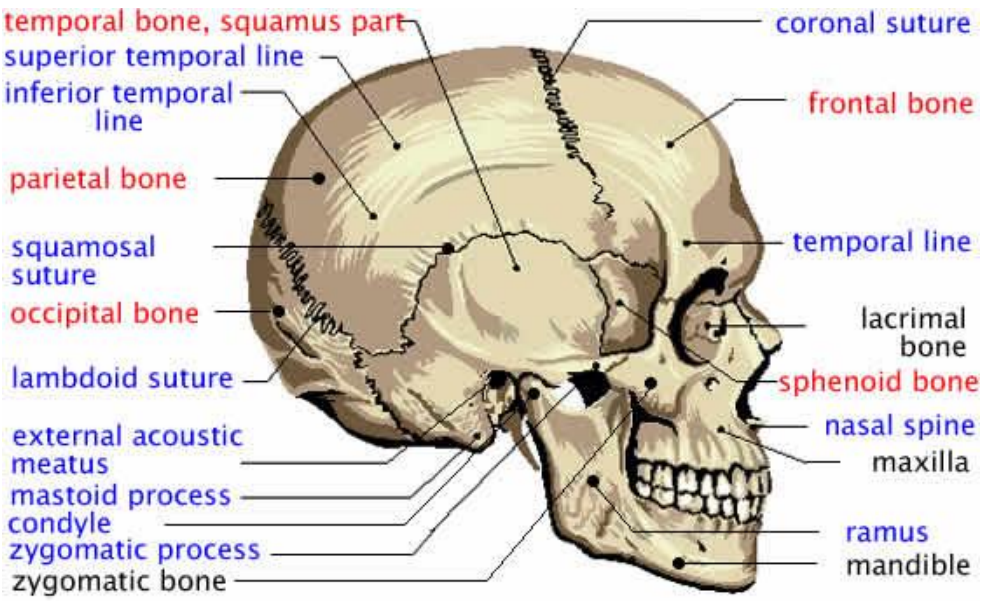
Axial Skeleton

Skull Bones and processes to Know:

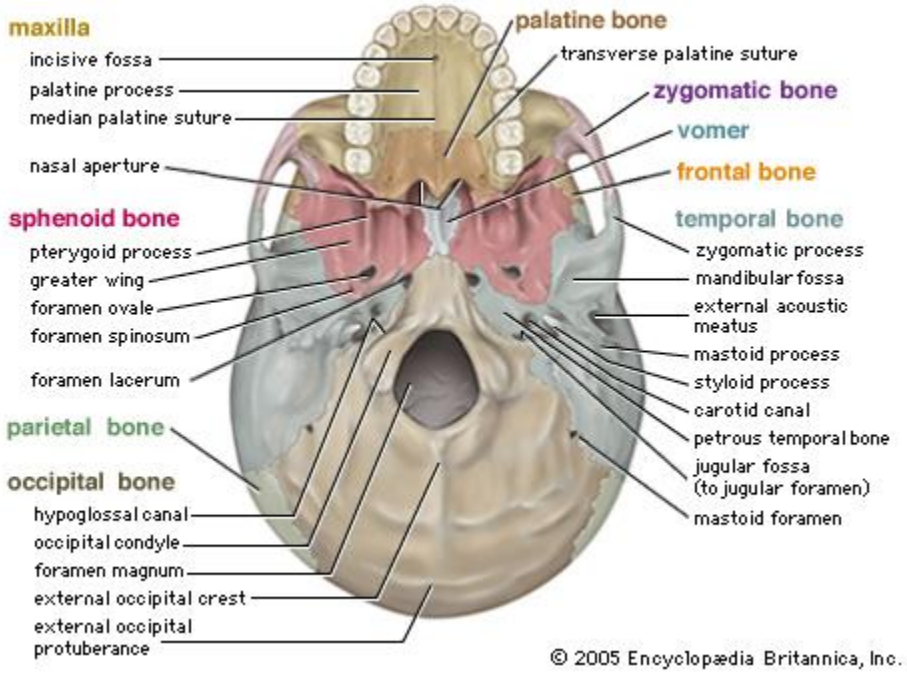
- Parietal bone
- Frontal bone
- Occipital bone
- External occipital protuberance
- Occipital condyle
- Nasal bone
- Sphenoid bone (greater wing)
- Temporal bone



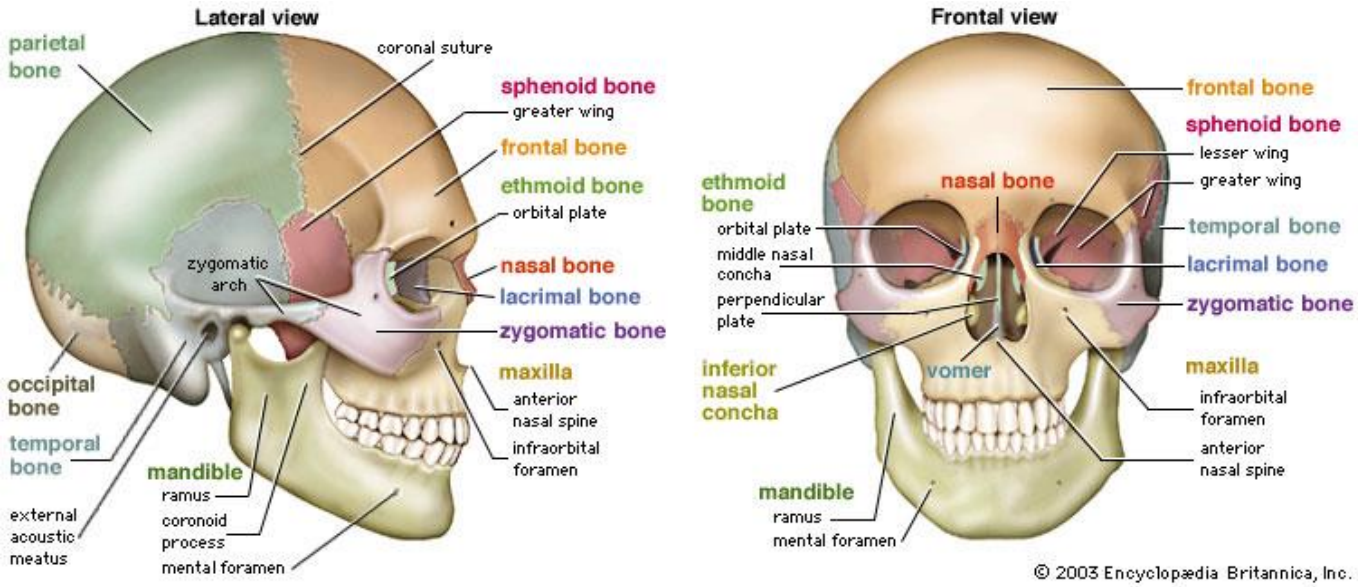
- Ethmoid bone
    - Middle nasal concha



    - Perpendicular plate
- Inferior nasal concha
- Vomer bone
- Lacrimal bone
- Zygomatic bone
- Maxilla
- Palatine bone
- Mandible
- Alveolar margin
- Supraorbital foramen
- Infraorbital foramen
- Mental foramen
- Superior orbital fissure
- Inferior orbital fissure
- Optic Canal
- Sagittal suture
- Coronal suture
- Squamous suture
- Lambdoid suture
- Occipitomastoid suture
- Mastoid process
- Styloid process
- Mandibular notch
- Mandibular ramus
- Mandibular angle

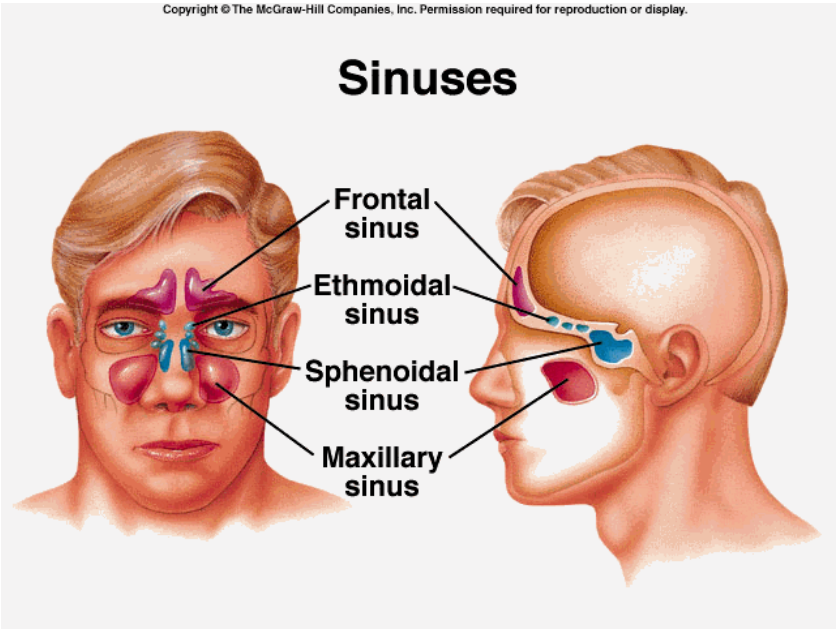


- Mandibular symphysis
- Mandibular fossa
- Temporomandibular joint
- Coranoid process
- External auditory meatus
- Foramen magnum
- Occipital condyle



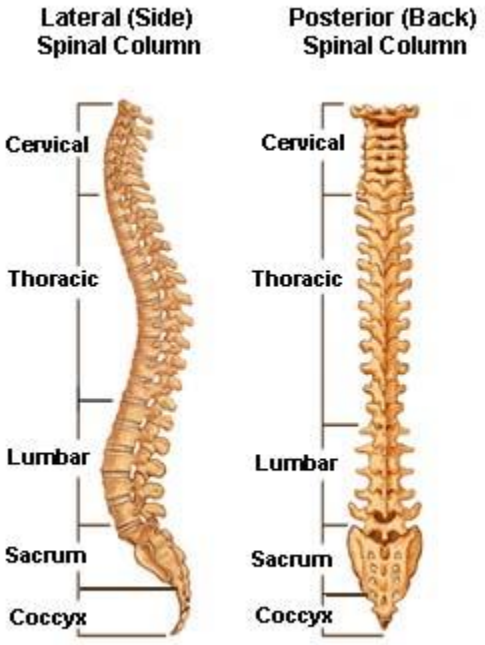
Sinuses

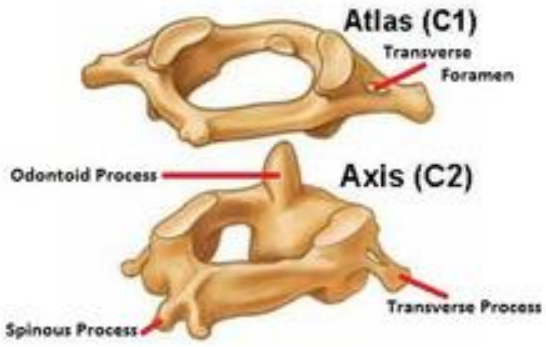
- Frontal sinus
- Ethmoid sinus
- Sphenoid sinus
- Maxillary sinus

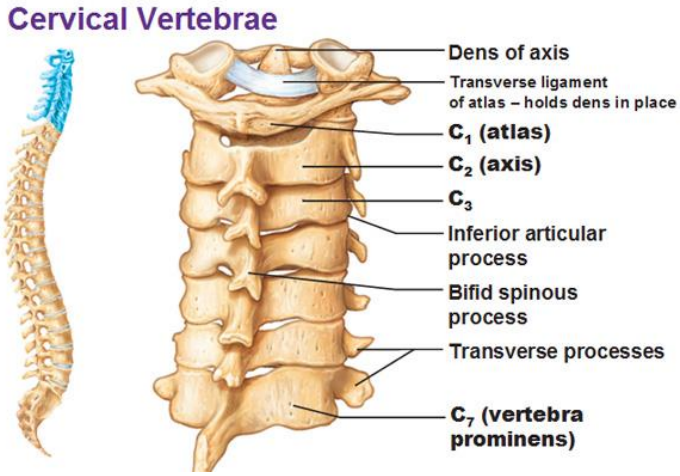


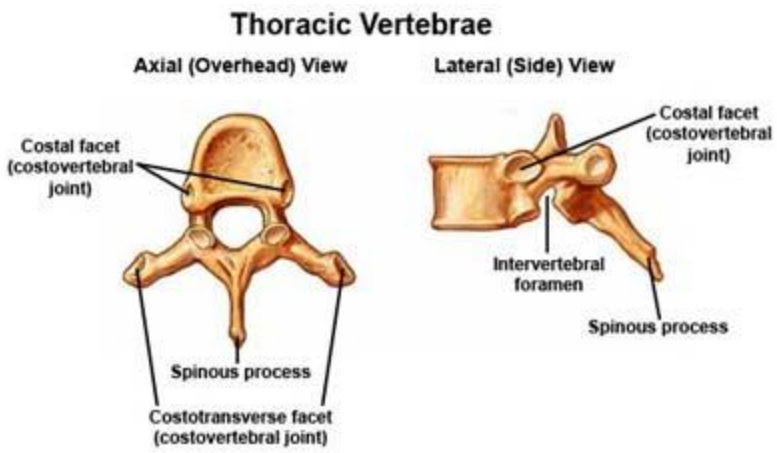
The Vertebral Column and the Vertebrae

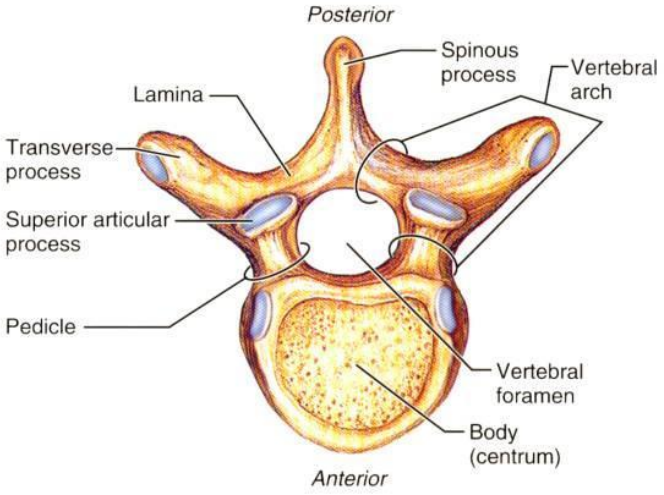
- Cervical Curvature (C1-C7) = concave
  - Atlas (C1)
  - Axis (C2)
  - Odontoid process (dens)
- Thoracic Curvature (T1-T12) = convex
- Lumbar Curvature (L1-L5) = concave
- Sacrum (5 fused) = convex
- Coccyx (4 fused)
- Spinous process
- Transverse process
- Intervertebral discs
- Vertebral foramen
- Superior articular process
- Pedicle
- Body (centrum)
- Transverse foramen
- Know the difference (by sight) between the three types of vertebrae.

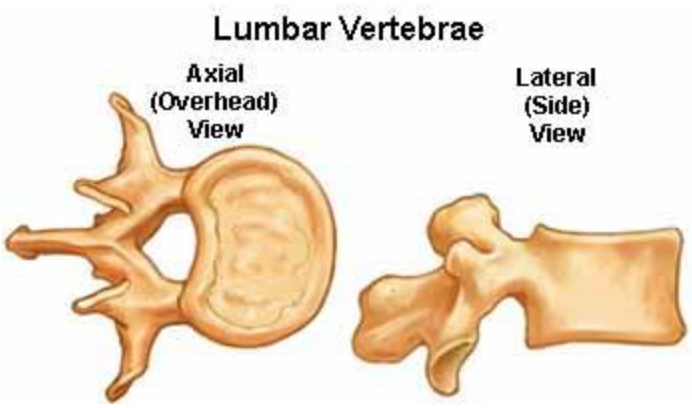


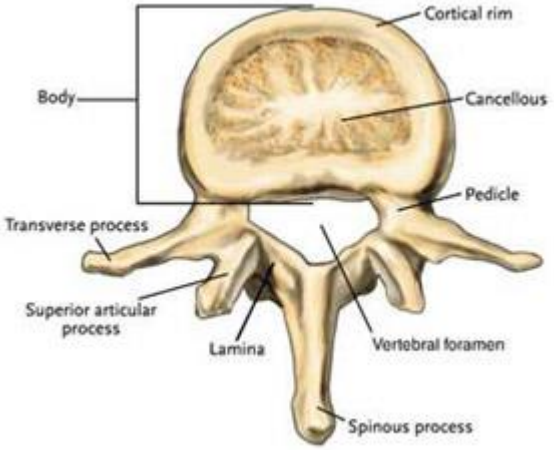





Thoracic Vertebrae
Axial (Overhead) View
Lateral (Side) View
Costal facet (costovertebral joint)
Costal facet (costovertebral joint)
Intervertebral foramen
Spinous process
Spinous process
Costotransverse facet (costovertebral joint)


Posterior
Spinous process
Vertebral arch
Lamina
Transverse process
Superior articular process
Pedicle
Vertebral foramen
Body (centrum)
Anterior

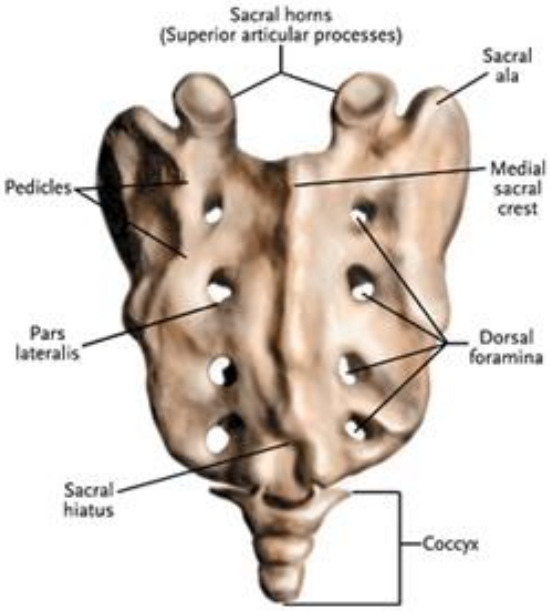

Lumbar Vertebrae
Axial (Overhead) View
Lateral (Side) View

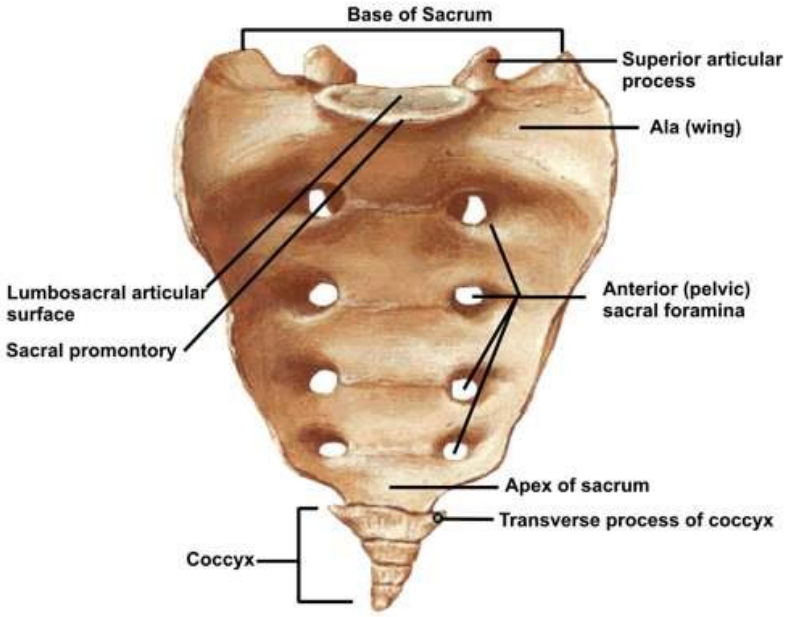

Cortical rim
Body
Cancellous
Pedicle
Transverse process
Superior articular process
Lamina
Vertebral foramen
Spinous process

Sacrum

- Ala
- Sacral promonitory
- Ventral / dorsal sacral foramina
- Sacral hiatus

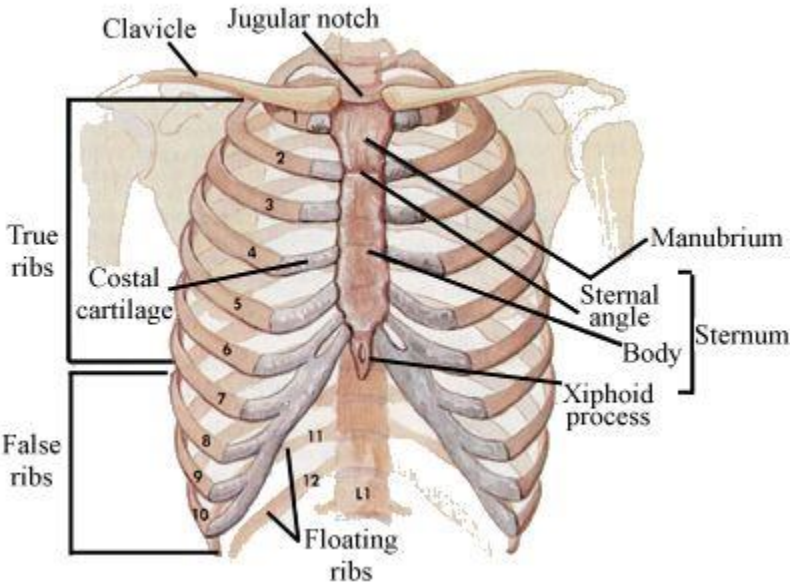
Coccyx

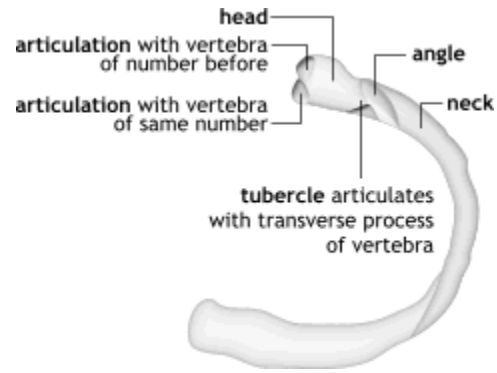




Bones and Process of the Ribcage

- True Ribs (1-7)
- False ribs (8-12)
- Floating Ribs (11, 12)
- Sternum
    - Manubrium
    - Sternal Body
    - Xyphoid process
    - Jugular notch
- Costal Cartilage
- Head of Rib
- Tubercle of Rib
- Angle of Rib
- Neck of Rib

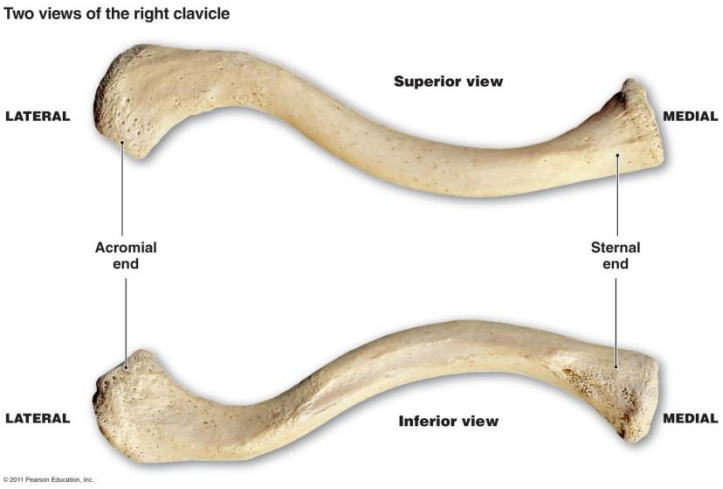




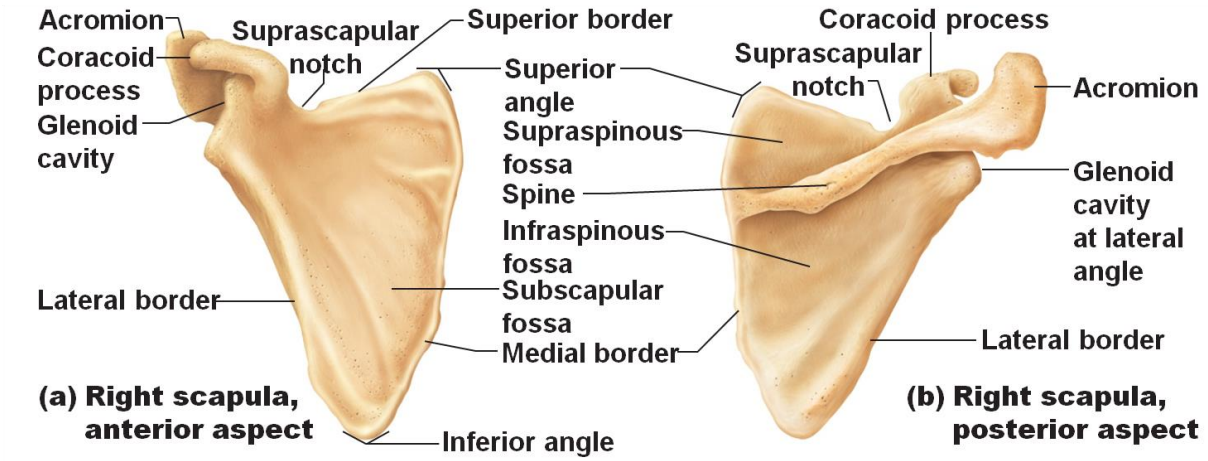
- Shaft of Rib

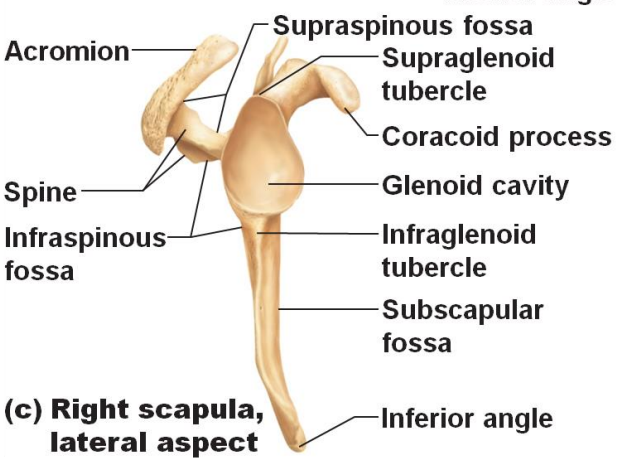
Appendicular Skeleton:

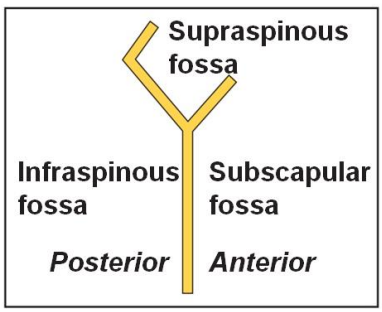
Bones of the Pectoral Girdle



- Clavicles
  - Acromial end
  - Sternal end
- Scapula
  - Acromion
  - Coracoid process
  - Glenoid fossa (cavity)
  - Lateral Boarder
  - Inferior angle
  - Medial Boarder
  - Superior Angle
  - Superior Boarder
  - Scapular Spine
  - Supraspinous fossa
  - Infraspinous fossa

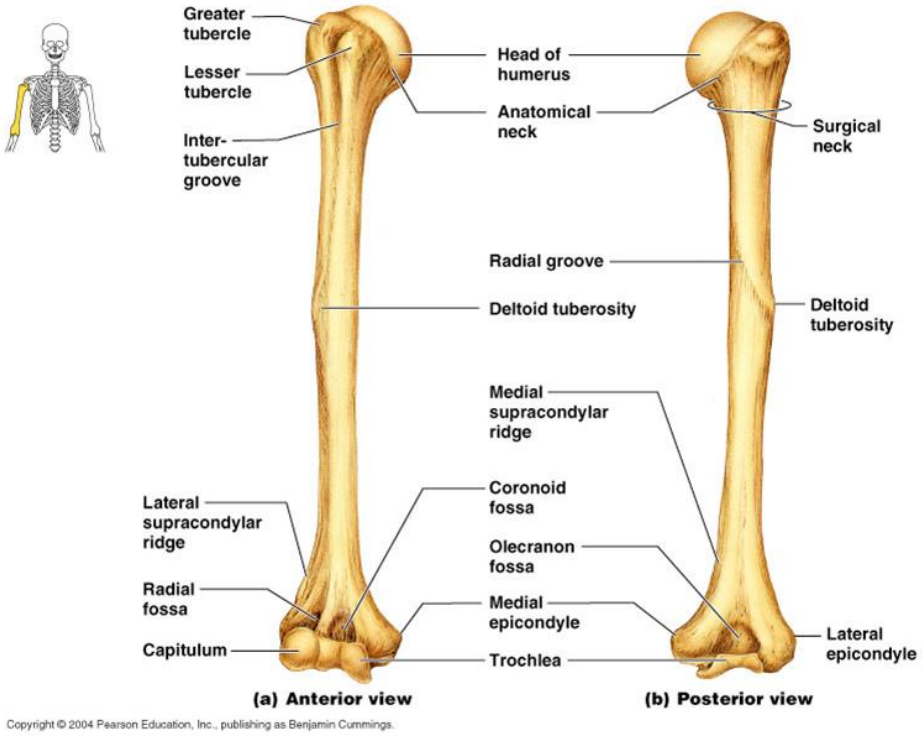






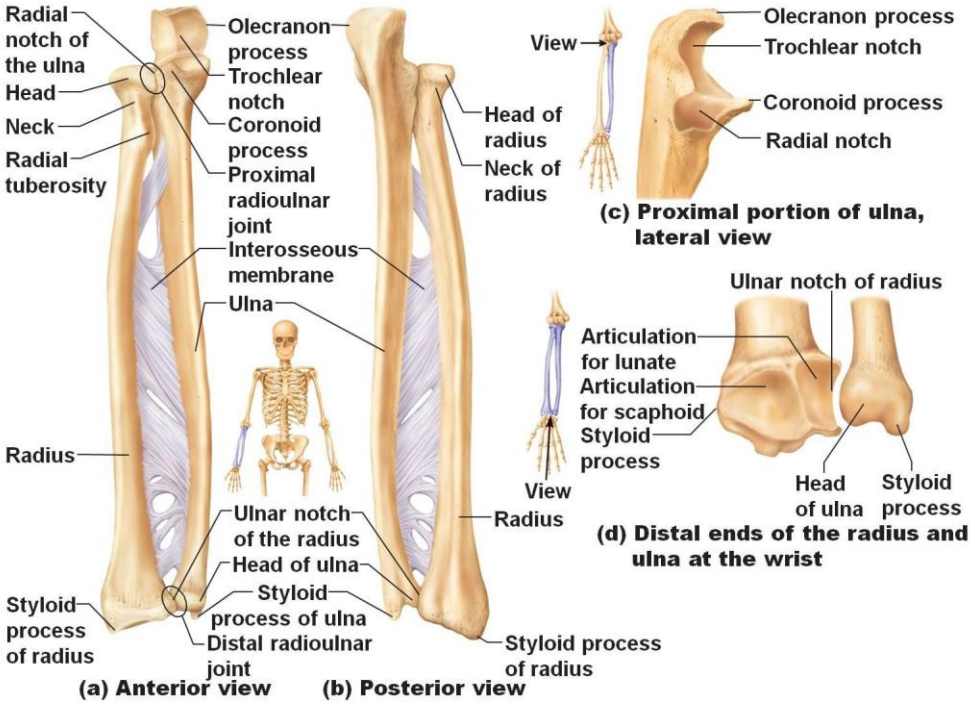
Upper Limb:

- Head of Humerus
- Anatomical neck
- Diaphysis
- Greater Tubercle
- Lesser Tubercle
- Deltoid Tuberosity
- Coranoid Fossa
- Medial Epicondyle
- Lateral Epicondyle
- Capitulum
- Trochlea
- Olecranon fossa



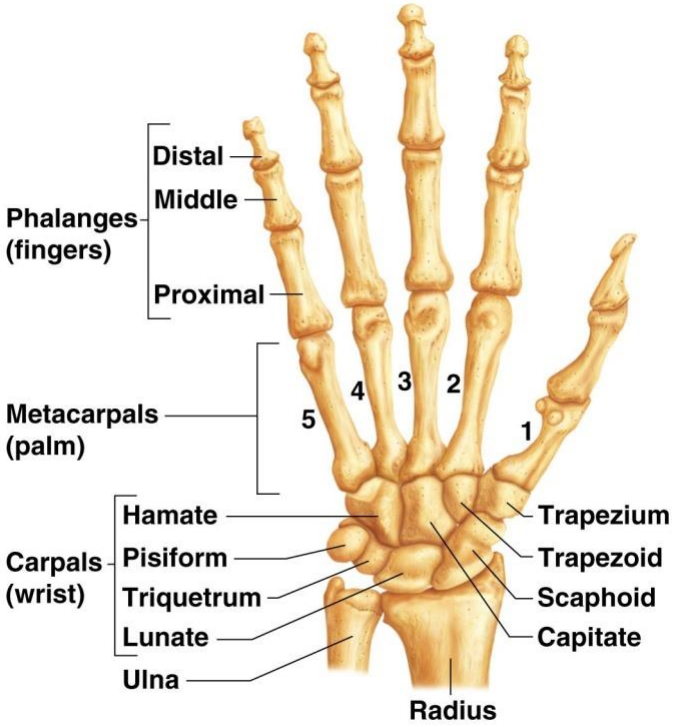
Radius and Ulna:

- Radius
- Ulna
- Radial Head
- Radial Tuberosity
- Radial Diaphysis
- Styloid Process of Radius
- Olecranon Process of Ulna
- Trochlear Notch
- Coranoid process
- Head of Ulna
- Styloid process of Ulna
- Ulnar Diaphysis



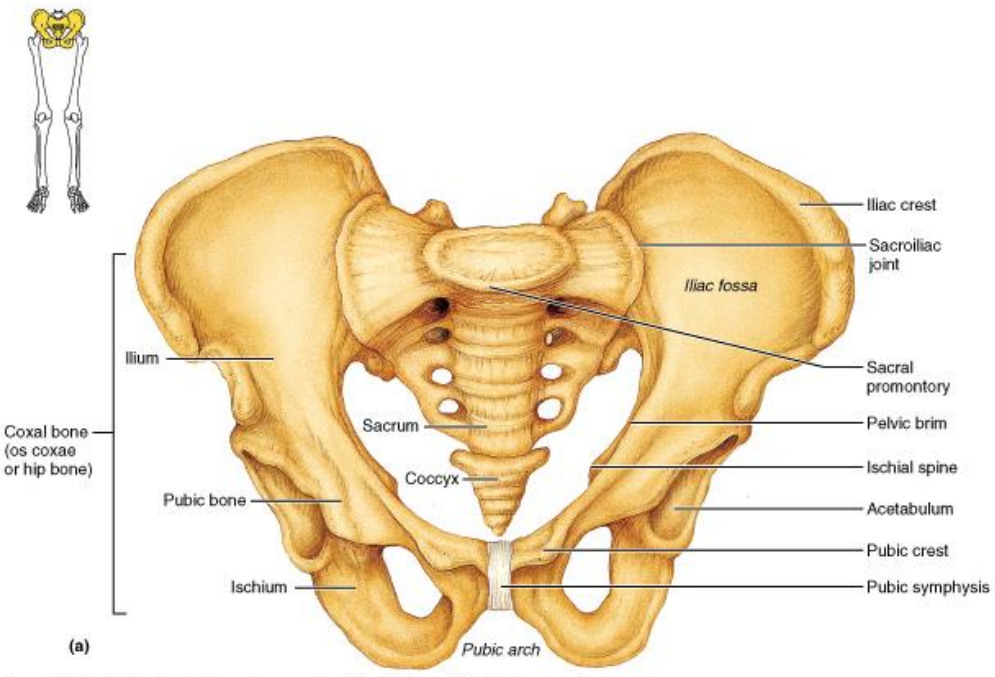
Wrist and Hand:

- Carpals (8)
- Metacarpals (5)
- Phalanges (14)
    - Proximal
    - Middle
    - Distal
- Be able to apply the appropriate numbering system to both the metacarpals and phalanges.

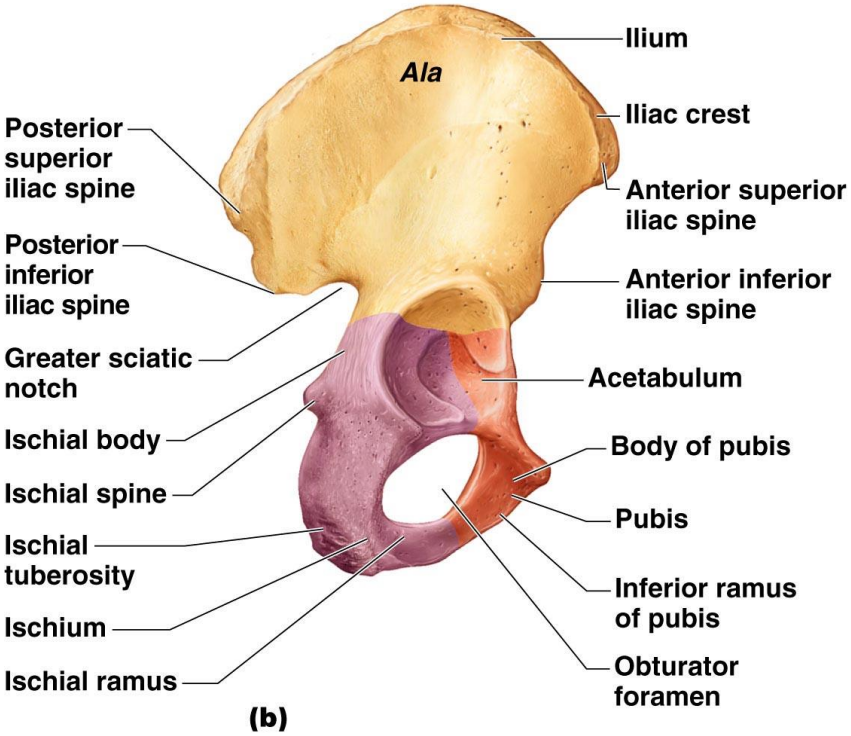


Pelvic Girdle

- Coxae
    - Pelvic brim
- Ilium
    - Iliac fossa
    - Iliac crest
    - Anterior Superior Iliac spine
    - Posterior Superior Iliac spine
    - Anterior Inferior iliac spine
    - Posterior inferior iliac spine

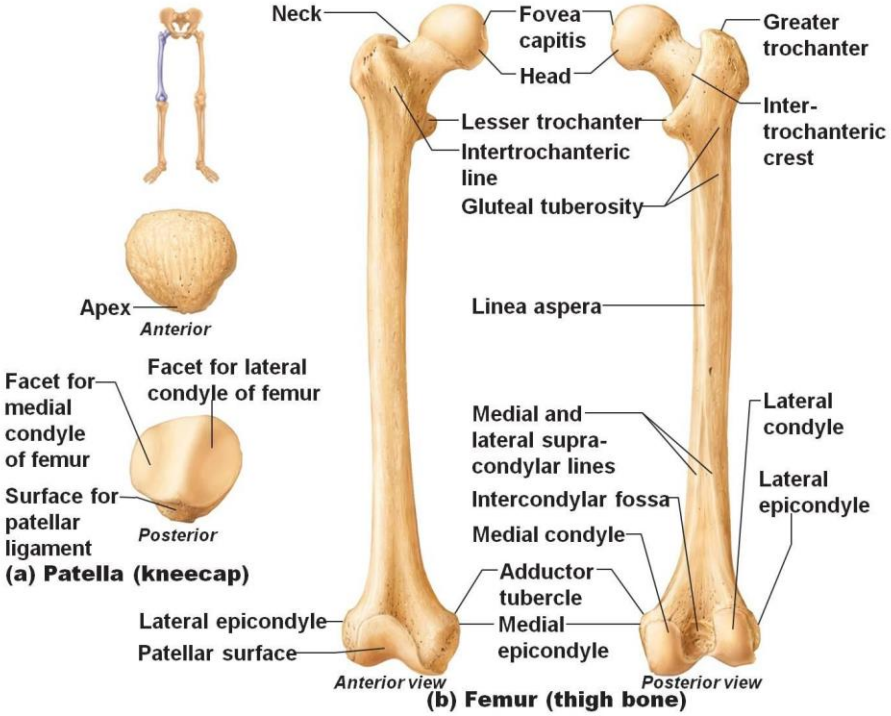


- Acetabulum
- Ischium
  - Ischial spine
  - Obturator foramen
  - Ischial body
  - Ischial tuberosity
  - Ischial ramus
- Pubis
  - Pubic crest
  - Pubic symphysis
  - Pubic arch
  - Inferior ramus of pubis



Femur and Patella

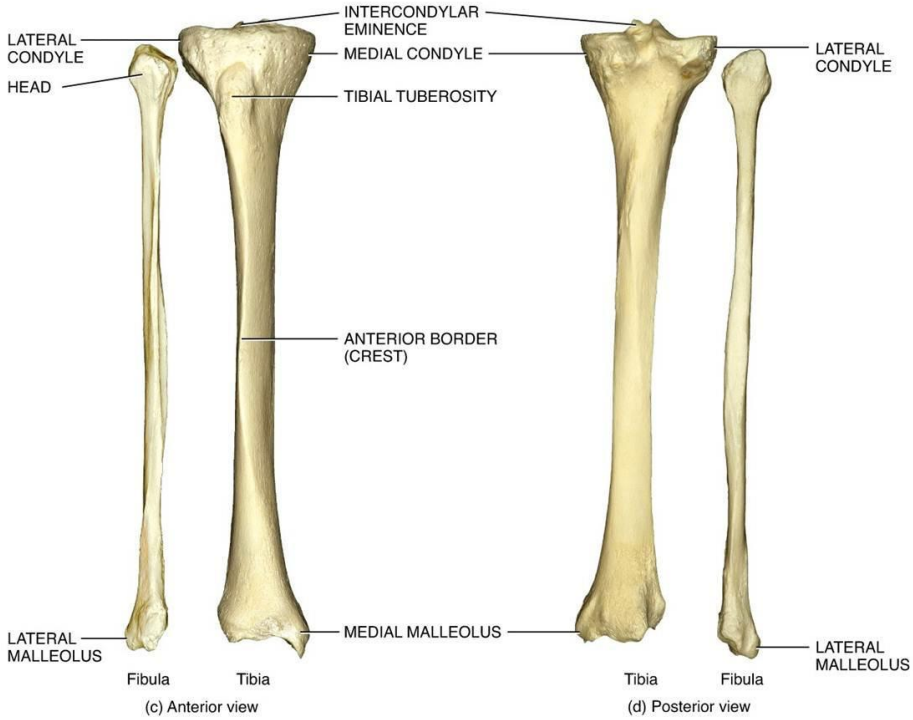
- Femur
  - Femoral Head
  - Greater Trochanter
  - Lesser Trochanter
  - Femoral neck
  - Femoral diaphysis
  - Medial Condyle
  - Lateral condyle
  - Medial epicondyle
  - Lateral epicondyle
  - Patellar surface
- Patella



Tibia and Fibula:

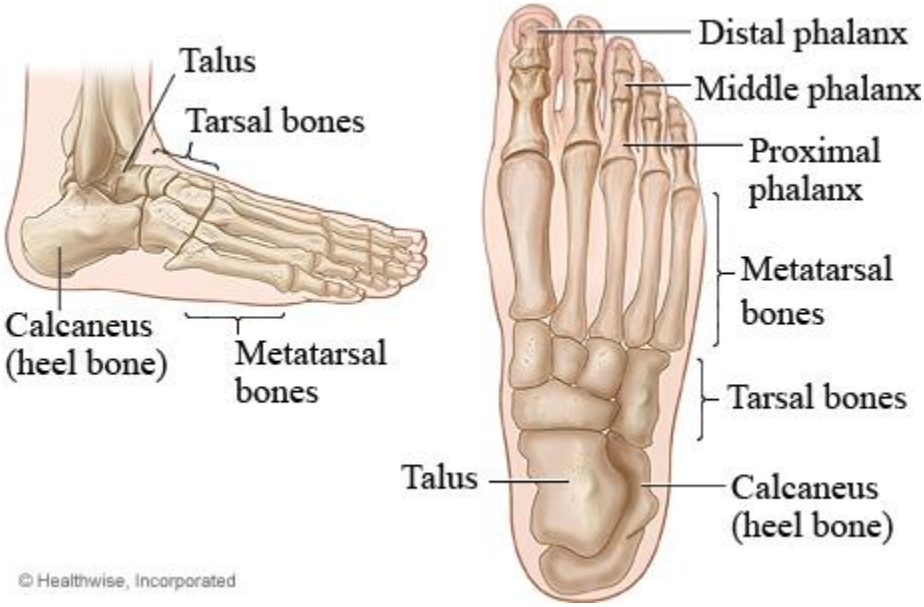
- Tibia
  - Articular surface of medial condyle
  - Articular surface of lateral condyle
  - Medial condyle
  - Lateral condyle
  - Tibial tuberosity
  - Anterior crest
  - Tibial disphysis
  - Medial malleolus

- Fibula
  - Fibular head
  - Lateral malleolus



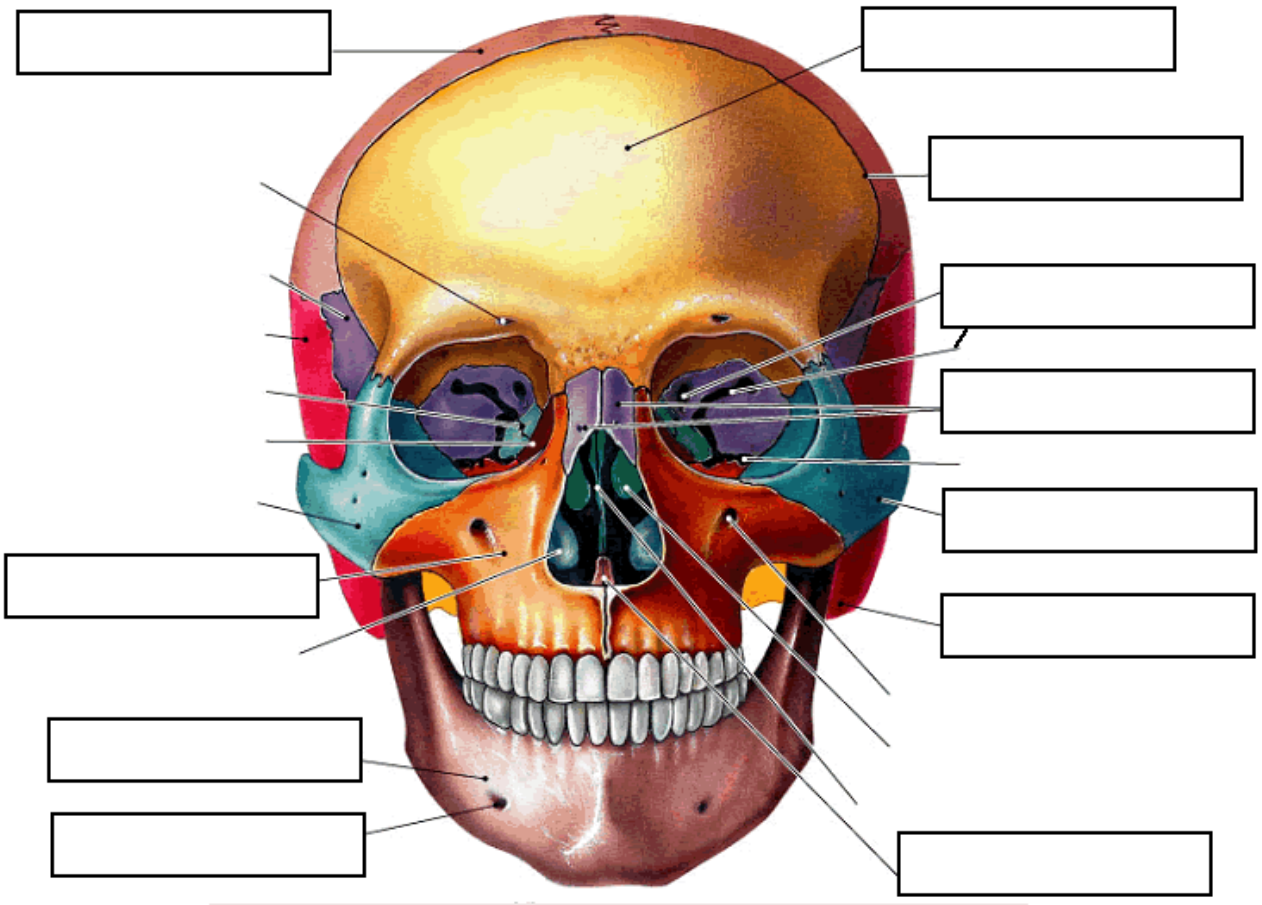
Foot

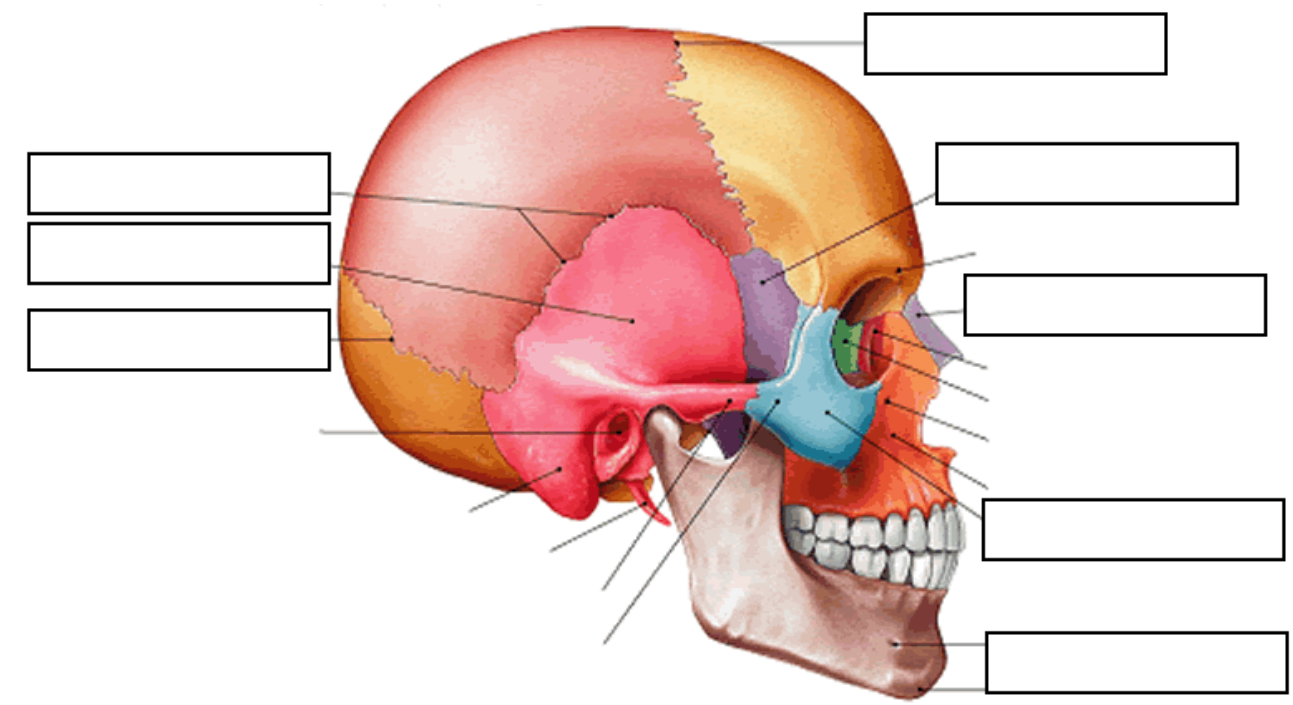
- Tarsals (7)
  - Calcaneus
  - Talus
- Metatarsals (5)
- Phalanges (14)
  - Proximal
  - Middle
  - Distal

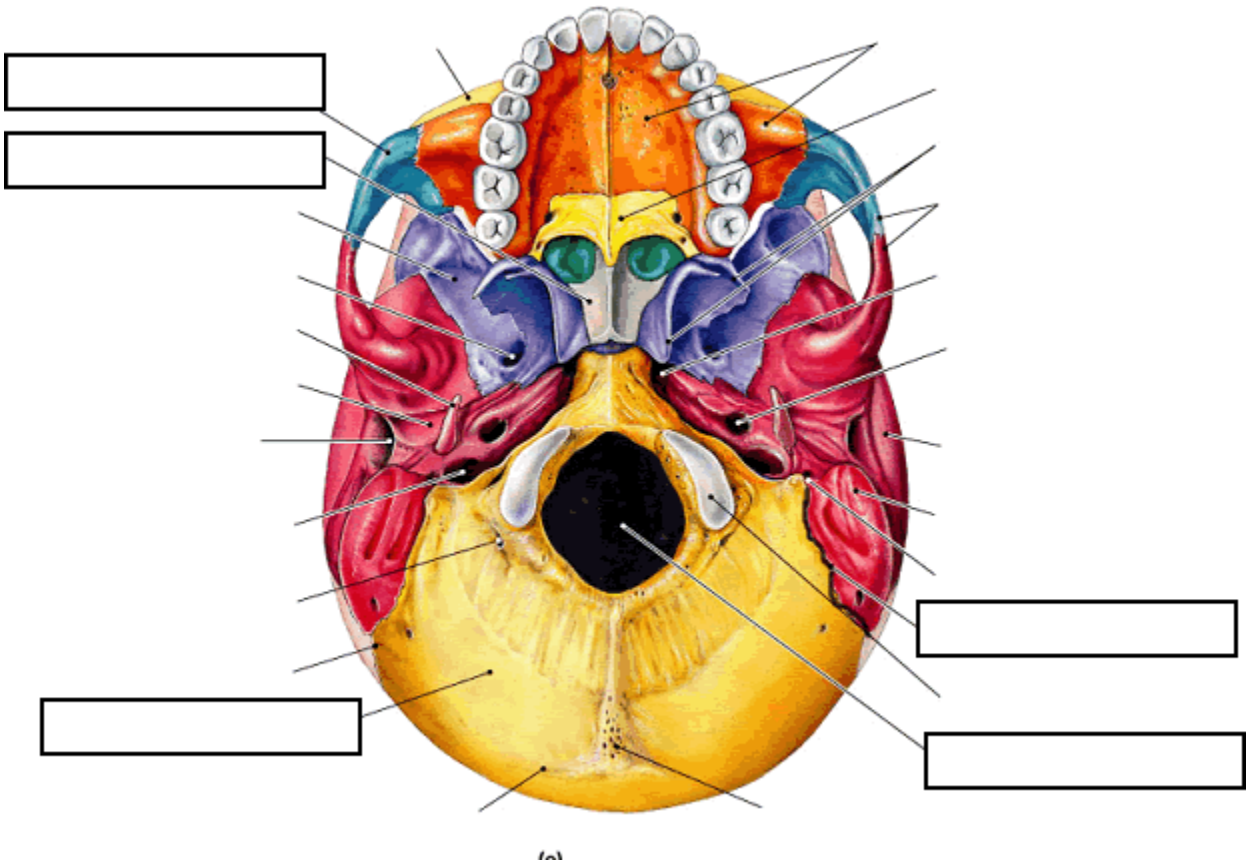


Name _____

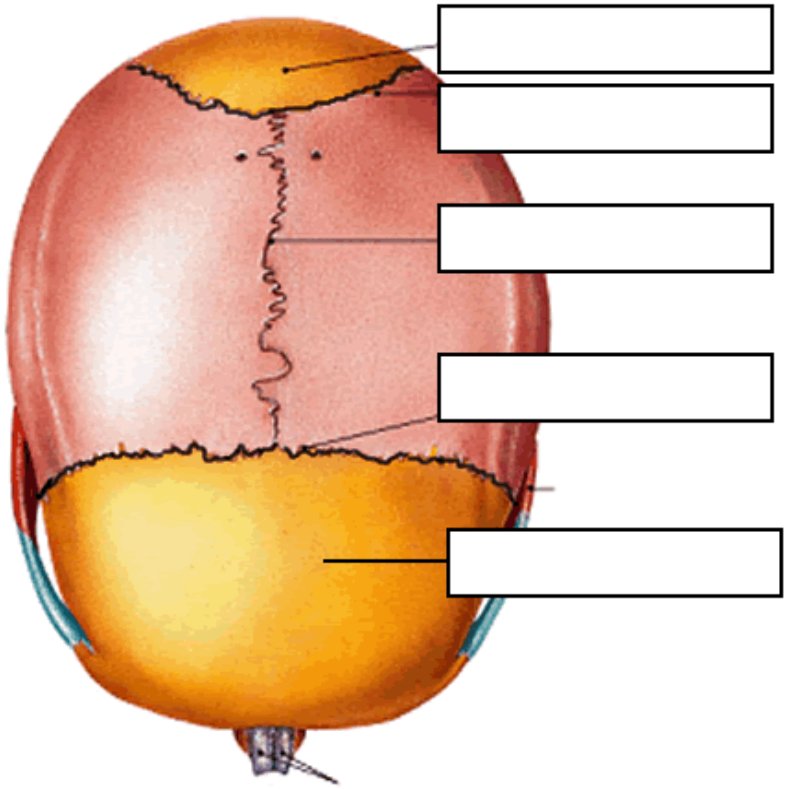
SKULL LABELING (Use your book/notes/internet for assistance)







SUTURES (no picture in book – use your BRAIN!)



X-RAY IDENTIFICATION ACTIVITY

Background

X-rays are a form of electromagnetic radiation, just like visible light. In a health care setting, a machines sends are individual x-ray particles, called photons. These particles pass through the body. A computer or special film is used to record the images that are created.

Structures that are dense (such as bone) will block most of the x-ray particles, and will appear white. Metal and contrast media (special dye used to highlight areas of the body) will also appear white. Structures containing air will be black, and muscle, fat, and fluid will appear as shades of gray.

Purpose

For each of the following x-rays answer the questions in the box next to it. Use your textbook or internet research to determine the bones present, type of injury, and what could have caused the injury.

1. What bones are present in this X-ray?
2. Are these bones in the axial or appendicular skeleton?
3. What specific bone(s) are injured in this X-ray?
4. What type of fracture/injury is present in this X-ray?
5. What may have caused this injury?

6. What bones are present in this X-ray?
7. Are these bones in the axial or appendicular skeleton?
8. What specific bone(s) are injured in this X-ray?
9. What type of fracture/injury is present in this X-ray?
10. What may have caused this injury?

11. What bones are present in this X-ray?
12. Are these bones in the axial or appendicular skeleton?
13. What specific bone(s) are injured in this X-ray?
14. What type of fracture/injury is present in this X-ray?
15. What may have caused this injury?

16. What bones are present in this X-ray?

17. Are these bones in the axial or appendicular skeleton?

18. What specific bone(s) are injured in this X-ray?

19. What type of fracture/injury is present in this X-ray?

20. What may have caused this injury?

21. What bones are present in this X-ray?
22. Are these bones in the axial or appendicular skeleton?
23. What specific bone(s) are injured in this X-ray?
24. What type of fracture/injury is present in this X-ray?
25. What may have caused this injury?

26. What bones are present in this X-ray?
27. Are these bones in the axial or appendicular skeleton?
28. What specific bone(s) are injured in this X-ray?
29. What type of fracture/injury is present in this X-ray?
30. What may have caused this injury?

31. What bones are present in this X-ray?

32. Are these bones in the axial or appendicular skeleton?

33. What specific bone(s) are injured in this X-ray?

34. What type of fracture/injury is present in this X-ray?

35. What may have caused this injury?

36. What bones are present in this X-ray?

37. Are these bones in the axial or appendicular skeleton?

38. What specific bone(s) are injured in this X-ray?

39. What type of fracture/injury is present in this X-ray?

40. What may have caused this injury?

41. What bones are present in this X-ray?

42. Are these bones in the axial or appendicular skeleton?

43. What specific bone(s) are injured in this X-ray?

44. What type of fracture/injury is present in this X-ray?

45. What may have caused this injury?

46. What bones are present in this X-ray?

47. Are these bones in the axial or appendicular skeleton?

48. What specific bone(s) are injured in this X-ray?

49. What type of fracture/injury is present in this X-ray?

50. What may have caused this injury?

SKELETAL SYSTEM CASE STUDY: The Case of the Unlucky Hiker

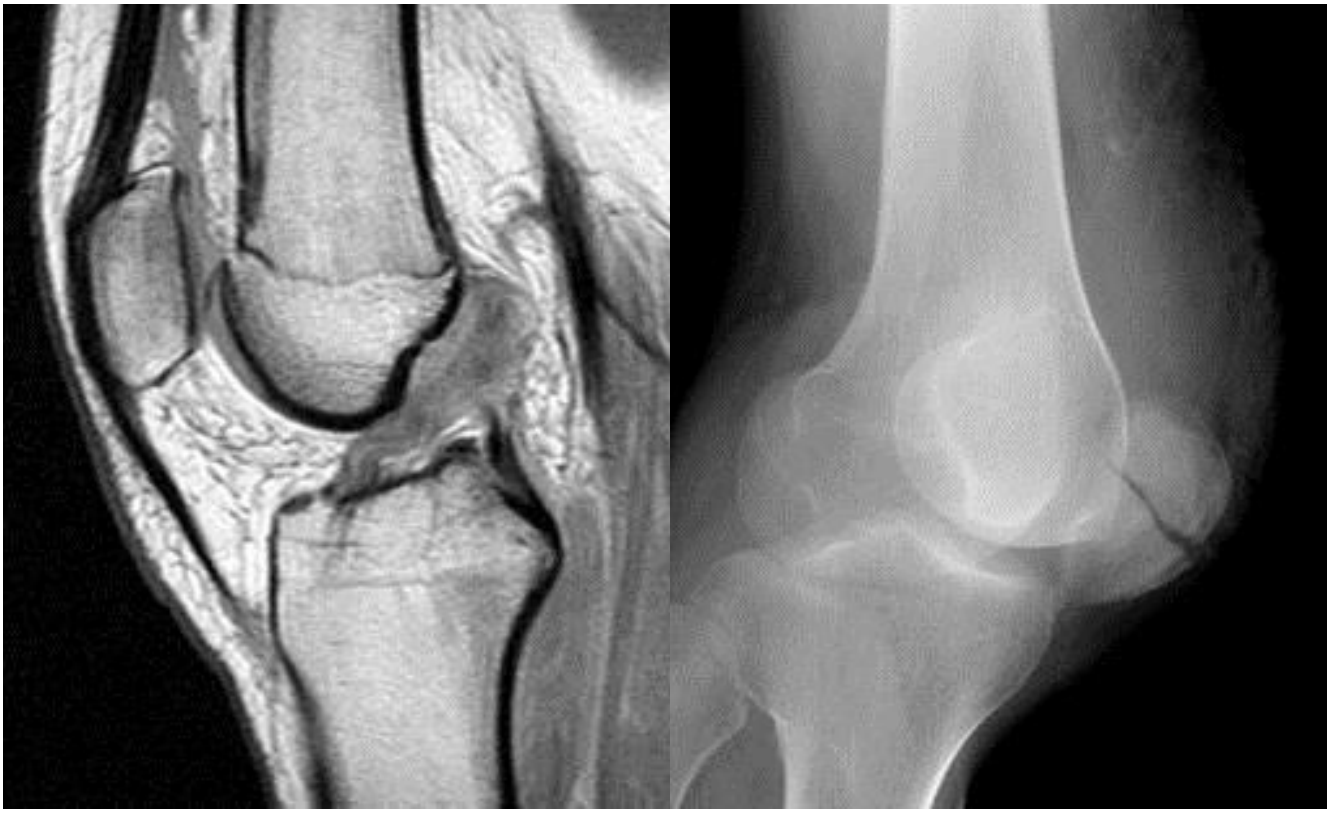
Emily, a 17 year old anatomy student at Forbush High School, spends her free time hiking in the foothills around her home observing the different landscapes in preparation for her studies in Coach Sewell's Earth Science class. One afternoon, Emily decides to spend her time hiking on less frequented trails in hopes of working on walking quietly while carefully observing the area around her. As usual, she lets her parents know where she is planning to go. After parking her car and checking her equipment and supplies, she sets off on a familiar trail, often visited by other hikers, mountain bikers and horseback riders. The day is warm and Emily is careful to drink frequently to minimize her chances of becoming dehydrated. Also, she snacks while hiking to maintain adequate blood glucose. As she rounds a bend in the trail, Emily notices a small herd of deer in the ravine below her and decides to try to move closer to them. After carefully checking the wind she starts to slowly move down the slope toward an overhanging ledge she noticed about halfway down. As she approaches the ledge, Emily loses her footing and begins to slide down the side of the ravine. She tries to catch herself at the ledge, but falls over the side of the ledge twisting her left knee and landing awkwardly on her left side. She continues to slide down the slope and finally comes to a stop at the edge of a grove of fir trees. While she does not lose consciousness, Emily is stunned and it takes her a few minutes to regain her composure. The first thing she notices is that her left leg is at an awkward angle and her left knee is very painful. When she tries to get up, she experiences pain in her left knee.

Remembering her anatomy studies in Coach Sewell's class, she feels fairly certain that she can draw some conclusions about her condition. Emily remains seated and uses her hands and a camping mirror from her daypack to evaluate her condition. Other than some minor scrapes and scratches Emily feels certain that she has not sustained any injuries to her arms, shoulders, ribs or abdominal organs. While she cannot be certain, she also believes that she has not sustained any injuries to her head, although she may have a mild **concussion**. Emily also cannot detect any extreme tenderness or **edema** in her abdominal region or ribs. Her right leg and shin seem to be "normal", however her left knee appears to be injured and is swelling quite rapidly. Emily arranges her daypack so she can elevate left leg and begins to think about the best way to progress. As she is thinking, Emily hears what sounds like voices coming from above her. She uses her whistle to signal to the people she hears. When they respond she yells to tell them where she left the trail and what happened to her. The people on the trail above her tell her that they will mark the location and return to her parents' house to send some help back. Emily replies that she thinks she may have injured her left knee and she will wait until help arrives.

While waiting for help, Emily continues to monitor her situation. She begins to feel chilled, so she puts her jacket on and has something to eat and drink. She also tries to remain alert by counting the number of bird species she notices. Approximately 90 minutes later she hears voices calling to her from above. She attempts to direct the rescue team to her position and within 30 minutes they arrive and complete a field evaluation. Their diagnosis concurs with Emily's and they transport her to the trail and then to the regional hospital. At the hospital Emily receives a thorough physical examination by an emergency room physician. She tells the emergency room physician that she thought she heard a "popping" sound when she twisted her knee as she started to fall. The results of this examination indicate that Emily has not suffered any major injuries other than torn knee ligaments in her left knee as well as a broken patella (see images below). The emergency room physician immobilizes the leg and calls for an **orthopedic** consultation regarding her knee. The results of the magnetic resonance image (MRI) of her knee indicate a **torn anterior cruciate ligament** and **medial meniscus**. Emily is scheduled for surgery to repair her knee the next day and kept in the hospital overnight for observation.

The next morning the orthopedic surgeon explains to Emily that he will be taking an **Achilles Tendon** from a **cadaver** to replace the torn knee ligaments and that this procedure will be done with the use of an **arthroscope**. The

surgeon also explains that Emily should begin physical therapy as soon as possible after surgery to minimize her recovery time. After a successful surgery, without complication, Emily awakens and is discharged after being instructed in the proper use of crutches and the degree to which she can **ambulate.** Two days later Emily is evaluated by a physical therapist and given a series of **rehabilitation exercises** to complete each day. Gradually, Emily regains strength and stability in her left knee and is given a series of exercises to complete three to four times each day.



Answer the following questions about this case

1. Define the bold terms in the text.

2. How does the anatomy of the knee differ from the anatomy of the elbow?

3. How do the cruciate ligaments in the knee aid in maintaining stability of the joint?

4. Why does swelling occur in Emily's left knee following the injury?

5. Why was Emily kept in the hospital overnight for observation?

6. What are the purposes of the rehabilitation exercises Emily is expected to complete?

Human Anatomy & Physiology: Muscular System Lab Series

Background Material:

When a person wants to show the size of his muscles, we say that he is flexing his muscles. When we study anatomy, we discover that the action of flexing a muscle will always cause a joint to bend. For example, when you flex the biceps muscle in your upper arm, your arm will bend at the elbow. To extend your arm (straighten it at the elbow joint), your triceps muscle must contract. The biceps and triceps work together as a pair to allow you to bend and straighten your arm. Two other groups of muscle pairs include the deltoid and the pectoralis major, which are also involved with moving the arm, and the hamstrings and quadriceps femoris groups that move the leg.

Materials Part 1

Microscope; microscope slides of muscle tissue; colored pencils

Part 1: Microscopic Structure of Muscle

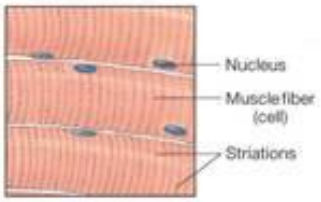
The muscles mentioned above are all skeletal muscles that function to move the bones. Visceral muscle (smooth muscle) and cardiac muscle differ from skeletal muscle in both structure and function. The differences in structure can be observed with the microscope. Examine a permanent slide of skeletal, cardiac, and visceral muscle. Refer to the photographs in your textbook as you examine the slide. Begin your observation with the skeletal muscle. After you have focused the skeletal muscle under low power, switch to high power for a detailed study of the tissue. Notice that the muscle appears to consist of many long, thin fibers packed tightly together. This arrangement produces the grain of the muscle. The dark spots are the nuclei of the cells. If you look carefully, you may see striations extending like fine, wavy lines across the grain of the muscle. Study the drawings below in this lab and label the one that you think is skeletal muscle.

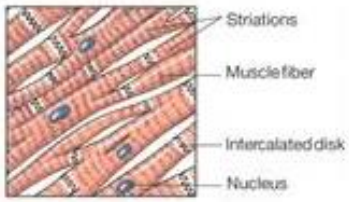
Now observe the cardiac muscle. Use low power first and then high power. Cardiac muscle also consists of long fibers, but they appear to be somewhat thicker than the skeletal muscle fibers, and the nuclei are larger. Study the drawings below in this lab and label the one that appears to be cardiac muscle.

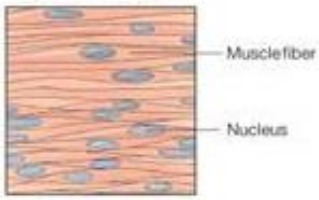
Continue your study of muscle by examining the visceral (smooth) muscle under low power first and then under high power. Notice that the fibers are arranged in a somewhat more irregular pattern -than those of skeletal muscle and cardiac muscle. Label the drawing below and label the one that appears to be visceral muscle. Check your labels on all three drawings and observe the tissues again if necessary to make sure that you have correctly labeled each one.

Part 1: Microscopic Structure of Muscle Diagrams

Label the type of muscle (skeletal, cardiac, or smooth) pictured.



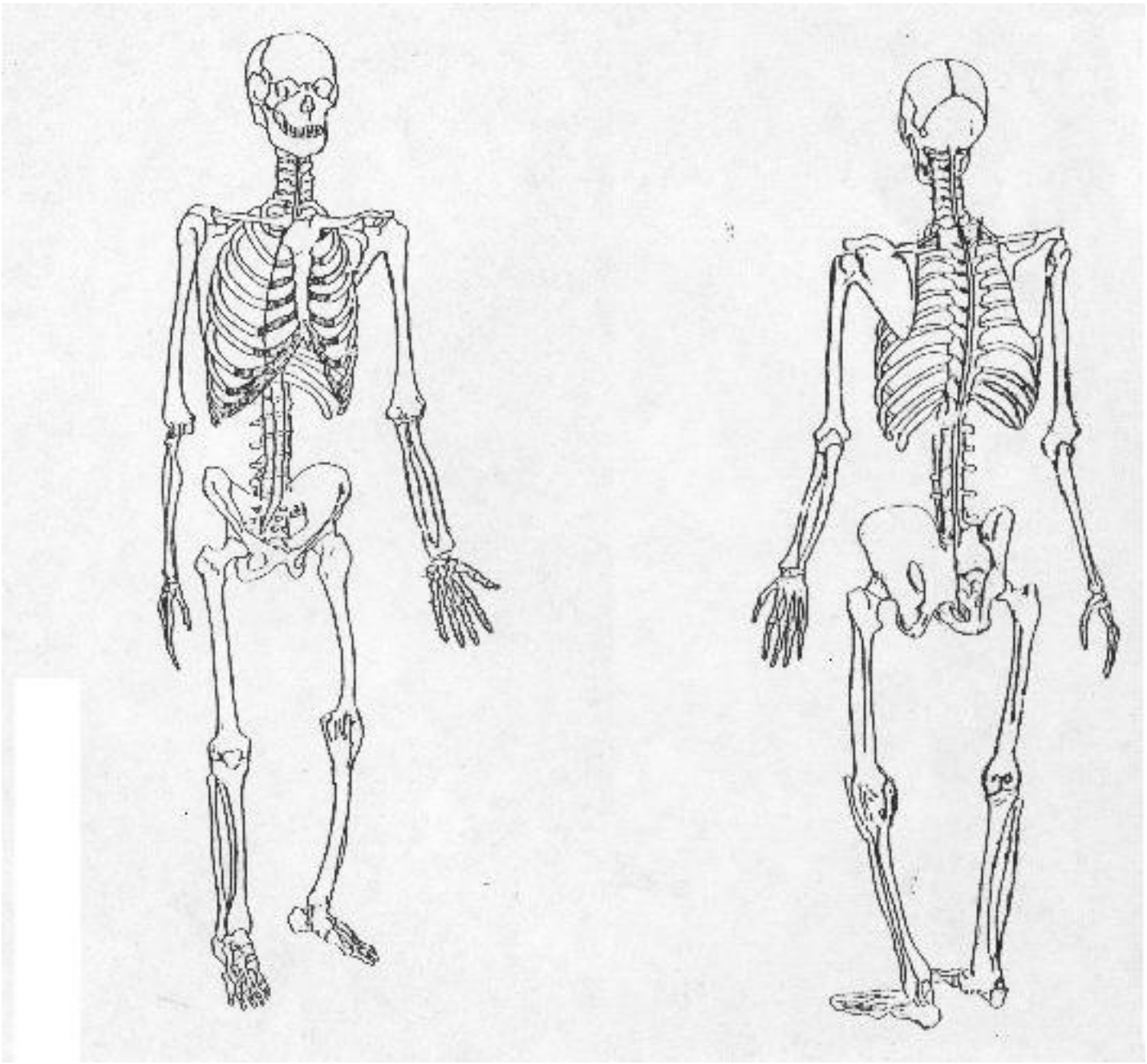




Identifying Human Muscles

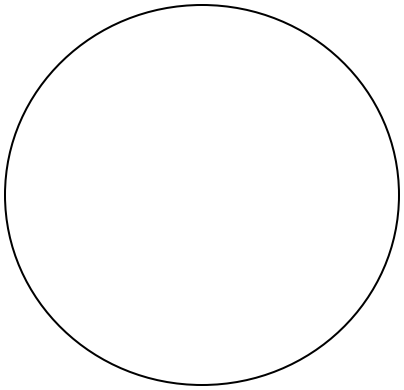
Draw each of the muscles listed below in its proper position on either the anterior or posterior view of the skeleton and color it as indicated. If a muscle is visible on both sides of the body, draw it on both views (anterior and posterior). List the function of each muscle next to its name on the chart.

Name of Muscle	Color	Function
Trapezius	yellow	
Gastrocnemius	black	
Masseter	dark green	
Intercostal muscles	dark blue	
Latissimus dorsi	brown	
External oblique	purple	
Gluteus maximus	orange	
Biceps	red	
Triceps white	(draw outline)	
Deltoid	light green	
Pectoralis Major	light blue	
Hamstring group gray	(use pencil lead)	
Quadriceps femoris group	blue ink	

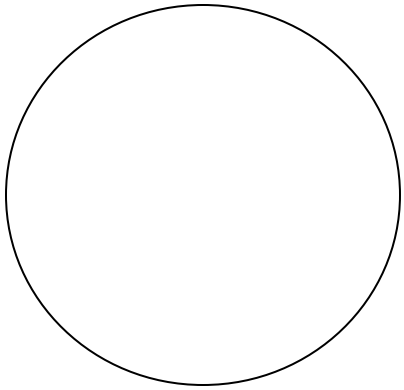


Procedures Part 1 - Microscope

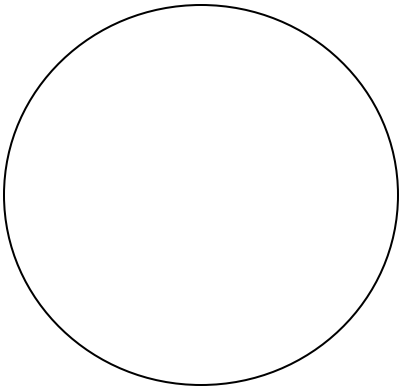
1. Observe and draw a preserved slide of a section of skeletal, smooth (visceral), and cardiac muscle.
2. Fill in the chart below, which deals with the three types of muscles.



Skeletal Muscle at _____ mag.



Smooth Muscle at _____ mag.



Cardiac Muscle at _____ mag.

Three Types of Muscles Chart

	Skeletal	**Smooth**	**Cardiac**
Voluntary or Involuntary?			
Striated or smooth?			
Where is it found?			
What does it control?			

Observations Part 1

1. Which of the three types of muscle appears to have the most parallel fibers?

_____

2. Which of the three types of muscle has the most irregular fibers?

_____

3. Which of the muscle types appears to have the largest nuclei?

_____

4. Which of the types of muscle appears to consist of fibers that connect side to side like the off ramp of interstate highways?

_____

Materials Part 2 – Experiment: Control of Muscles

- clock with a second hand

Procedures Part 2 – Experiment: Control of Muscles

Blink your eyes three times, then immediately begin holding your eyes open as long as you can. Do not roll your eyes around as you hold them open. Have a friend time you.

- How long were you able to keep your eyes open without blinking? _____ seconds

Rest your eyes for at least five minutes with normal blinking and eye movement.

- Try the experiment again. How long were you able to keep your eyes open? _____ seconds

Rest your eyes and try the experiment again.

- How long were you able to keep your eyes open? _____ seconds

What is the average amount of time you can keep your eyes open? _____ seconds

Compare your average to the average amount of time that other people in your class are able to keep their eyes open without blinking. Is there a significant difference? _____

If there is a significant difference, what do you believe could account for it?

Analysis and Conclusions for Part 2 – Experiment: Control of Muscles

1. What is a voluntary action?

2. List several examples of muscle actions that are voluntary.

3. What is an involuntary action?

4. List several examples of muscle actions that are involuntary.

5. The reaction of blinking your eyes is stimulated when the surface of the eye begins to dry out. This action of blinking your eyes is controlled by muscles. Are the muscles that blink your eyes voluntary, involuntary, or both? _____

- List several other actions that are controlled in the same way that eye blinking is.

Background Material Part 3: Chicken Wing Structure

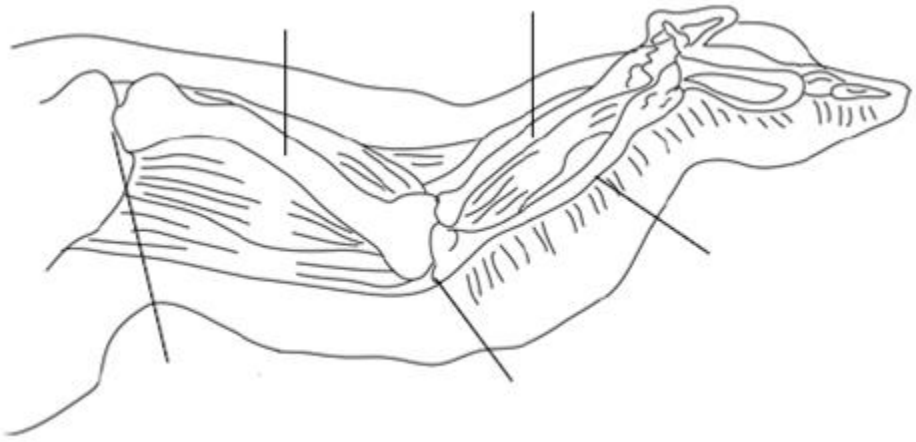
Vertebrates all have internal skeletons with muscles attached to parts of the skeleton. By examining a chicken wing, you can see the various parts of this vertebrate's skeleton and muscular systems. These parts are similar to those found in humans.

Materials Part 3: Chicken Wing Structure

Chicken wing, raw	Gloves
Goggles	Lab apron
Dissecting pan	Microscope, compound
Dissecting pins	Microscope slides and coverslips
Dissecting probe	Paper towels
Dissecting scissors	Scalpel
Forceps	Toothpicks

Procedure Part 3: Chicken Wing Structure

1. **CAUTION:** Put on goggles, gloves, and lab apron before you begin this activity. Keep hands away from face when doing this activity. Wipe away any spills and pick up dropped objects to prevent slips and falls. Put the chicken wing in the dissecting pan.
2. **CAUTION:** Be sure to cut away from yourself. Using the dissecting scissors, cut under the skin from the exposed end of the upper wing to the first joint.
3. Pull the skin completely from the muscles and joints of the chicken wing, using your fingers and the forceps.
4. Rinse the wing with water and gently dry with paper towels.
5. Use a dissecting probe to gently touch the muscles to observe their structures.
6. Find the tendons. They are the white cords that attach the muscle to the bone.
7. Observe the muscles and tendons of the wing. Label as much as you can on the diagram (shoulder joint, humerus, radius, ulna, carpals, phalanges).



8. Move the lower part of the wing while holding the upper portion still. Observe the pair of opposing muscles controlling this movement.

9. Move the wing tip while holding the lower wing still. Observe the pair of opposing muscles controlling this movement.
10. **CAUTION:** Be sure to cut away from yourself. Use the scalpel to cut the muscles from the bones.
11. Investigate the joints of the wing. Observe the ligaments. These are the tough, white cords that connect two bones.
12. Separate the bones at the joints by twisting the bones in opposite directions. Observe the cartilage that covers the bone.

CAUTION: Wash hands thoroughly when finished to avoid *Salmonella*.

Analysis and Conclusions Part 3: Chicken Wing Structure

1. What could be the function of the cordlike structure of the tendons?

2. What is a function of cartilage?

3. Describe how the muscles, tendons, bones, ligaments, and joints work together to move the lower wing.

Background Material Part 4: Muscle Fatigue

Muscles work with the skeletal system to move parts of your body In order for the muscles to work, they must have a supply of sugar, which can be burned to provide energy However, when a muscle uses up its supply of available energy, it begins to ache and cramp rather than work properly This cramping is called muscle fatigue. The better physical condition a person is in, the longer his or her muscles can work without experiencing muscle fatigue.

Materials Part 4: Muscle Fatigue

- Binder clips (the type that is used to hold several papers together)

Procedure Part 4: Muscle Fatigue

You can do a very simple test to demonstrate muscle fatigue. Obtain a binder clip from Mr. Sewell. Hold the ends of the clip between the tips of your index finger and your thumb. Begin pinching the clip open and then allowing it to close slowly (over a 5 second interval). Continue this action as many times as possible, counting the number of times you can open the clothespin. Stop when the muscle between your thumb and index finger begins to cramp.

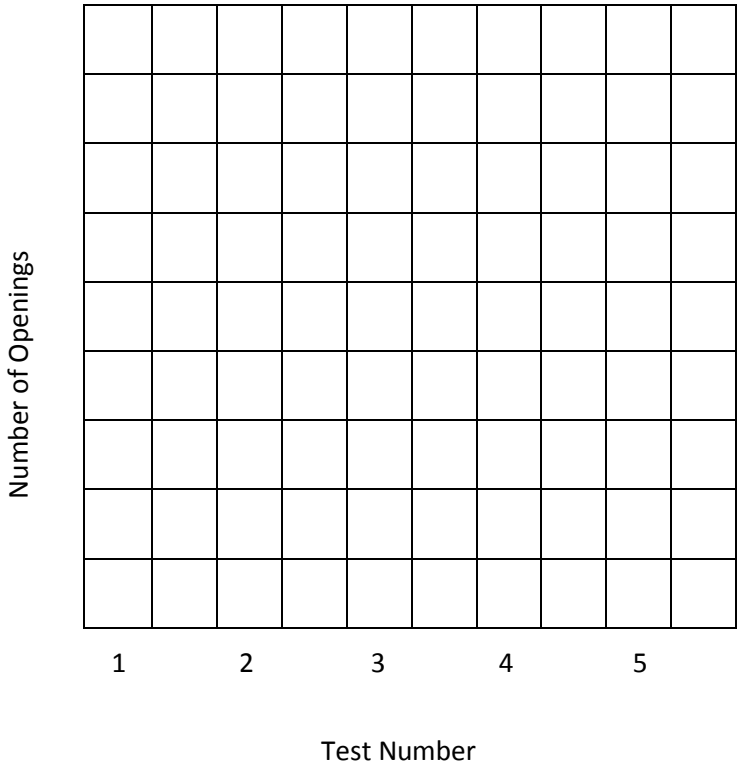
- How many times were you able to open and close the clothespin? _____

Wait two minutes and try this test again. Repeat the test a total of five times, allowing a two-minute rest between each test. For each test, record the number of times you were able to open and close the clothespin. Record your results in the table.

Table of Muscle Fatigue	
Test	**Number of Openings**
Test 1	
Test 2	
Test 3	
Test 4	
Test 5	

Analysis and Conclusions Part 4: Muscle Fatigue

1. Make a graph that shows the number of times you were able to open and close the binder clip in each trial.



2. What does your graph indicate about the onset of muscle fatigue with each succeeding trial?

3. If a person is involved in some unaccustomed physical activity for several hours, what happens to his or her ability to perform the activity?

Muscular Dysgeny

A Case Study on the Muscular System
Human Anatomy and Physiology

Muscular dysgenesis or dysgeny is a lethal, recessive, genetic disease of mice that is caused by a mutation in the mdg gene. Skeletal muscles from dysgenic mice are paralyzed and the animals die shortly after birth.

You are a research scientist interested in finding the cause of the cellular defect associated with this genetic disease.

You surgically remove a single muscle fiber from a dysgenic mouse fetus and place it in an experimental chamber in order to study abnormalities in the control of skeletal muscle activity during dysgenesis.

1. Which of the following structures is NOT a part of the muscle fiber?

A. transverse tubule
B. motor end plate
C. sarcolemma
D. synaptic knob
E. sarcoplasmic reticulum

2. You briefly apply a high concentration of acetylcholine (ACh) directly to the motor end plate and observe no contraction of the fiber. Since muscular dysgenesis only affects one type of cell in the body, you would suspect that the motor neurons of dysgenic mice work normally. True or False?

A. True
B. False

3. Arrange the events at the neuromuscular junction in the proper sequence from first to last

1. arrival of the action potential at the synaptic knob
2. generation of action potential in sarcolemma
3. binding of ACh to ACh receptors in the motor end plate
4. release of ACh into the synaptic cleft
5. removal of ACh from the cleft by acetylcholinesterase

A. 1, 2, 3, 5, 4
B. 2, 3, 1, 4, 5
C. 1, 4, 3, 2, 5
D. 2, 5, 1, 4, 3

4. After you apply acetylcholine to the muscle fiber, you find that an action potential is generated in the sarcolemma. This result proves that certain events or conditions occur normally within the neuromuscular junction. Which event or condition is NOT PROVED by the above result?

A. ACh receptors are present in the membrane of the motor end plate
B. ACh receptors bind to ACh
C. Sodium permeability of the end plate membrane is increased
D. Acetylcholinesterase breaks down ACh

5. Arrange the events of excitation contraction coupling in the proper sequence from first to last

1. cross-bridge cycling
2. action potential in the sarcolemma reaches the triads
3. release of calcium from the sarcoplasmic reticulum
4. exposure of active site on the thin filaments
5. binding of calcium to troponin

A. 2, 3, 5, 4, 1
B. 5, 3, 4, 2, 1
C. 5, 1, 3, 2, 4
D. 3, 5, 2, 4, 1

6. You artificially raise the calcium concentration within the sarcoplasm of the muscle fiber and observe that the cell contracts normally. From this observation, you conclude that the defect in muscular dysgeny occurs at which step in control of the muscle fiber?

A. Exposure of the active site on thin (actin) filaments
B. Binding of calcium to troponin
C. Release of calcium ions from the sarcoplasmic reticulum into the sarcoplasm
D. Repeated cycles of crossbridge binding, pivoting, and detachment

7. Where in the muscle fiber do you suspect that the normal protein made by the mdg gene functions in normal mice?

A. motor end plate
B. triad
C. myofibrils
D. thin filaments

8. All of the following conditions would have same effect on muscles (flaccid paralysis) as muscular dysgeny with a single exception. What is the EXCEPTION?

A. botulism
B. poisoning with atropine
C. poisoning with military nerve gas
D. myasthenia gravis

9. You would expect the muscles from an animal afflicted with muscular dysgenesis to exhibit:

A. hypertrophy
B. atrophy

10. You would expect that a dysgenic mouse dies shortly after birth because:

A. the heart fails to beat
B. vasoconstriction of the carotid artery prevents blood flow to the brain
C. vasodilation of the systemic blood vessels causes the blood pressure to drop to lethal levels
D. the respiratory muscles are unable to contract

CAT DISSECTION GUIDE

Goals:

- To demonstrate proper technique in dissecting procedures
- To correctly identify major anatomic structures
- To understand the intricacy and interconnectedness of the body

RULES:

1. No food or drink in the classroom
2. Follow all directions and guidelines
3. No unauthorized dissections
4. No unauthorized photos
5. Wash and DRY dissecting equipment and try at the end of each class period
6. Properly return all supplies

REVIEW OF ANATOMICAL TERMINOLOGY

Define the terms and label the cat.

Cranial:

Dorsal:

Proximal:

Medial:

Anterior:

Caudal:

Ventral:

Lateral:

Posterior:

Superficial:

Deep:

You will be responsible for and graded on the following:

I. Muscle identification

II. Thoracic Cavity Structures

III. Abdominal Cavity Stuctures

IV. Heart

V. Major Arteries and Veins

VI. Excretory Structures

VII. Reproductive Structures

I. Skinning the Cat

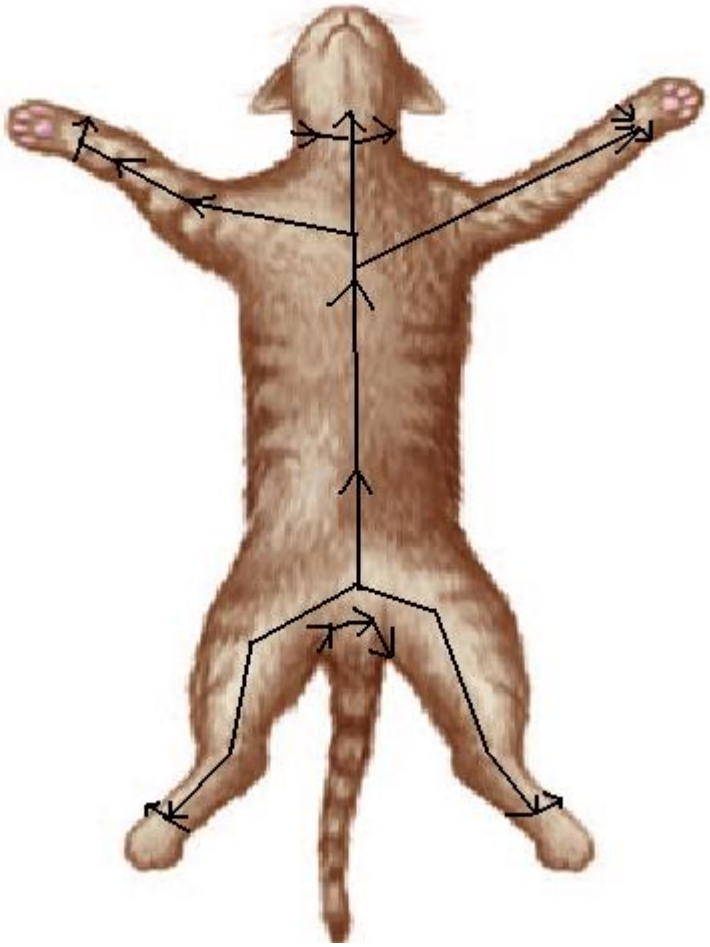


Figure 1: Skinning the Cat

1. Referring to Figure 1: pinch the skin on the ventral surface of the neck. Using scissors carefully make a small, longitudinal incision at the midline through the skin only. Use care not to cut into the underlying muscle layer.

2. Continue cutting longitudinally along the midline toward the lower lip and then posteriorly, stopping anterior to the genital area.

3. Cut the skin around the neck.

4. Make a horizontal cut across the chest and continue cutting down the midline of the extremities as indicated in Figure 1. Make diagonal cuts in the groin and continue midline down the extremities. Cut the skin around all paws.

5. Use your fingers to carefully peel the skin from the underlying muscles. Cutaneous muscles, such as the platysma, are attached to the undersurface of the skin and will be removed as you peel away the skin.

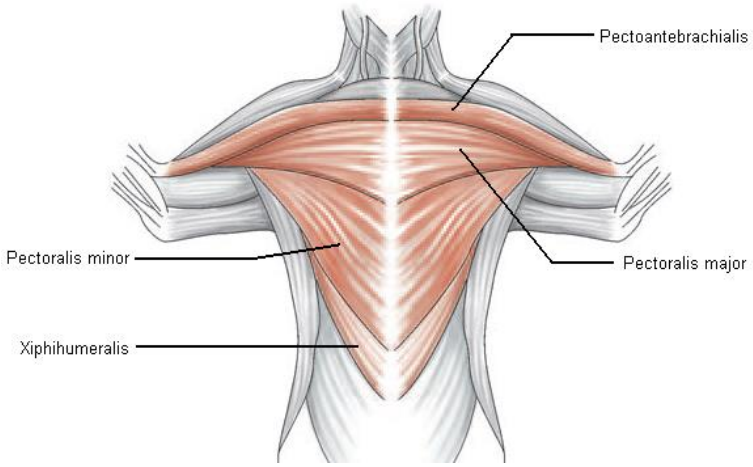
6. Continue peeling the skin until it is only attached at the face and the tail. Cut around the base of the tail, leaving the skin on the tail. Cut the skin around the face of the cat, leaving the skin on the face, ears, and forehead. Peel the skin from the head and save it.

7. Carefully remove as much fat and superficial fascia as possible with your fingers or forceps.

8. Wrap the skin around the cat and follow your instructor's directions for storing your cat in the plastic bag. The skin will prevent the tissues from drying out and prevent the growth of bacteria and mold. Dispose of fascia and fat as indicated by your instructor. Do not forget to attach the label identifying your cat before storing it.

II. Muscle Identification

Muscles to Identify

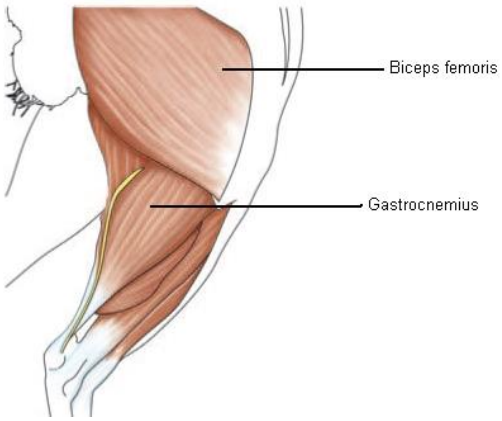


Ventral superficial thoracic and arm muscles

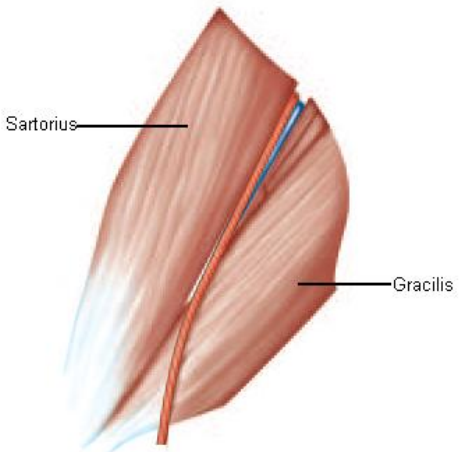
<u>Letter on Pin/Diagram</u>

- Clavobrachialis (2)
- Epitrochlearis (5)
- External abdominal Oblique (8)
- Pectoantebrachialis (14)
- Pectoralis Major (15)
- Pectoralis minor (16)
- Triceps brachi (19)
- Xiphihumeralis (21)

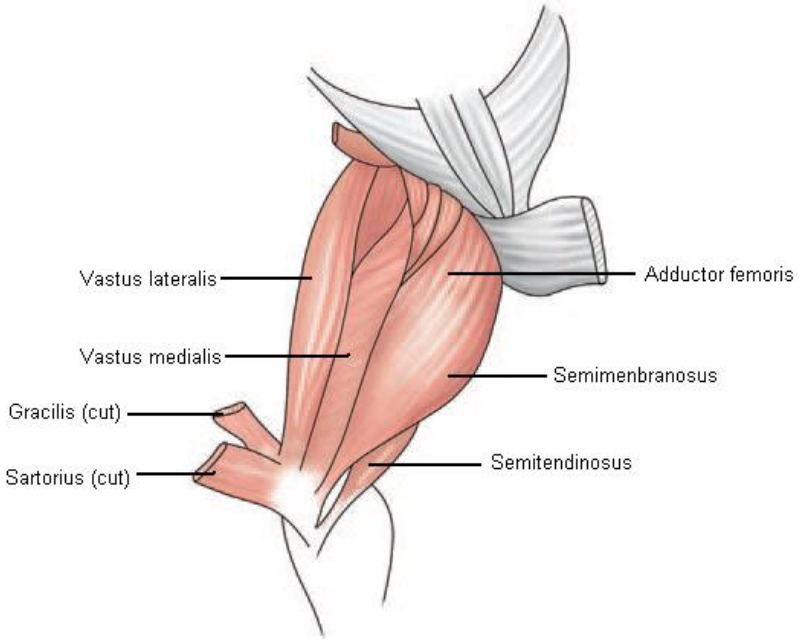
Superficial Muscles of Hind Limb



- Biceps femoris (2)
- Caudofemoralis (3)
- Extensor digitorum (4)
- Fascia lata (6)
- Gastrocnemius (7)
- Sartoris (15)
- Semitendonosus (20)
- Tibialis anterior (18)



Deep Muscles of Hind Leg – Dorsal view



- Adductor femoris (1)
- Extenor digitorum longus (4)
- Gastrocnemius(6)
- Semimebranous (15)
- Tensor Fascia Latae (18)

Deep Muscles of Hind Leg – Ventral view

- Caudofemoralis (1)
- Extensor digitorum longus (3)
- Fascia Lata Over Vastus Lateralis (4)
- Gastrocnemius(7)
- Semimembranosus (13)
- Semitendinosus (14)

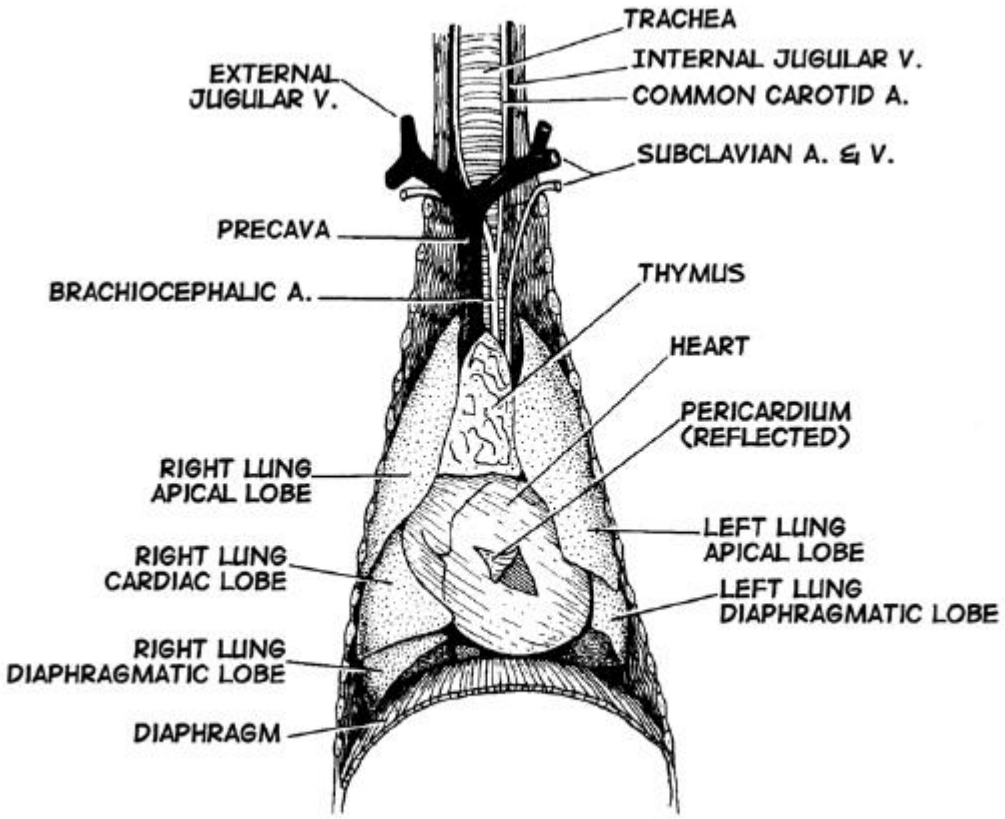
III. Thoracic Cavity Structures

Thoracic Cavity

Use Diagram #2 to help you identify the structures in this section. Open the thoracic cavity by cutting through the muscles and rib cartilages on the left side of and parallel to the sternum. Keep the scissors pointed ventrally (toward you) as much as possible to avoid damaging structures in the cavity. Pull the walls of the cavity lateral breaking the ribs. The **thymus gland** is a mass of dark brown tissue embedded in the fat cranial to heart. Carefully remove the thymus and fat from around the major organs. Use a probe and forceps instead of a scalpel. Take care to avoid damaging the blood vessels.

The **heart** lies in the **pericardial cavity**, delineated by the tough **pericardium**. The lungs lie in the **pleural cavities**, the other subdivisions of the thoracic cavity. The right lung has three major lobes, the **apical**, **cardiac**, and **diaphragmatic**, and a fourth smaller **intermediate** lobe, more dorsal in position and associated with the postcava. The left lung has two lobes, the **apical** and **diaphragmatic**. Follow the trachea and esophagus as they enter the thorax. Dorsal to the heart, the trachea divides into left and right **bronchi**, which carry air to and from the lungs. Defer dissection of this region until after removal of the heart in Part II.

The esophagus continues dorsal to the heart and penetrates the muscular **diaphragm** to enter the **abdominal cavity**. The periodic contractions of the diaphragm, together with the forward and outward movement of the ribs, increase the volume of the pleural cavities and cause inspiration of air into the lungs.



Be sure you can identify the following parts:

Trachea
Larynx
Esophagus
Thymus gland
Heart
Pericardium
Bronchi
Right lung apical lobe
Right lung cardiac lobe
Right lung diaphragmatic lobe
Right lung intermediate lobe
Left lung apical lobe
Left lung diaphragmatic lobe
Diaphragm

IV. Abdominal Cavity Structures

Use Diagrams 3, 4 and 5 to help you identify the structures in this section. Open the abdominal cavity by making a single incision through the ventral body wall from the end of the sternum to the pubis. Cut the body wall also along the edges of the rib cage and reflect the muscle sheets laterally to expose the viscera.

DIAGRAM 3: VISCERA OF THE ABDOMEN

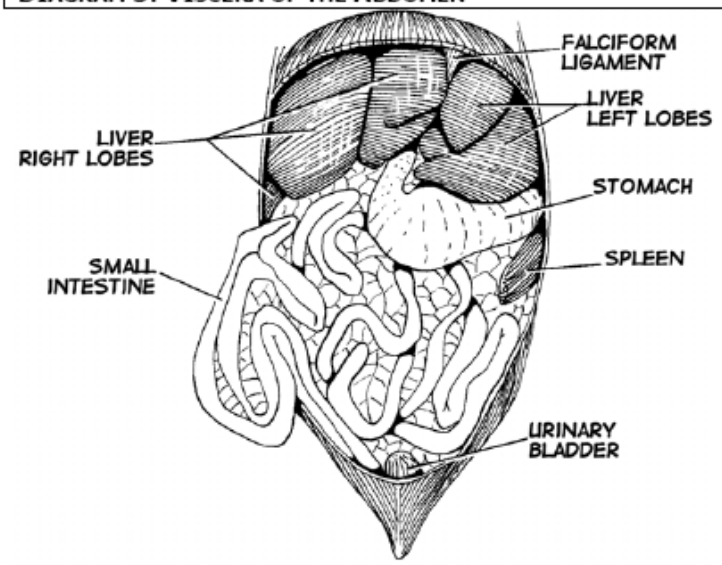
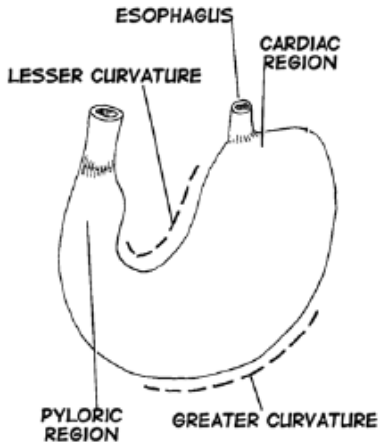


DIAGRAM 4: STOMACH



Anteriorly, the dark lobes of the **liver** should be visible. The mesentery between the liver and the diaphragm is the falciform ligament. It divides the liver into right and left sides. The lobe of the right side of the liver closest to the midline (the right median lobe) contains the dark green **gall bladder**. You may need to lift the right median lobe of the liver and look under it in order to see the gall bladder. You may need to cut and remove part of the right median lobe to see the gall bladder

Identify the **stomach**. The stomach is attached to the liver and part of the small intestine by a mesentery called the **lesser omentum**.

Attached to the greater curvature of the stomach is the **greater omentum**, an extensive sheet of mesentery laden with fat. It extends caudally and covers most of the remaining abdominal viscera. Cut the greater omentum near its attachment to the stomach and remove it. Try to keep all the other mesenteries intact. Identify the regions and parts of the stomach and cut it open to expose its inner surface. Note the **gastric rugae**, the large longitudinal ridges. Size of the stomach in the mink, as in other carnivores, depends on how recently and how well the individual ate. If the stomach in your animal is full of food, it may be enormous. The stomach is closed by contraction of the **pyloric sphincter**. When the sphincter relaxes, food is permitted to pass into the small intestine.

The **spleen** is a greenish-brown organ lying in a mesentery on the left side of the stomach. Locate the spleen.

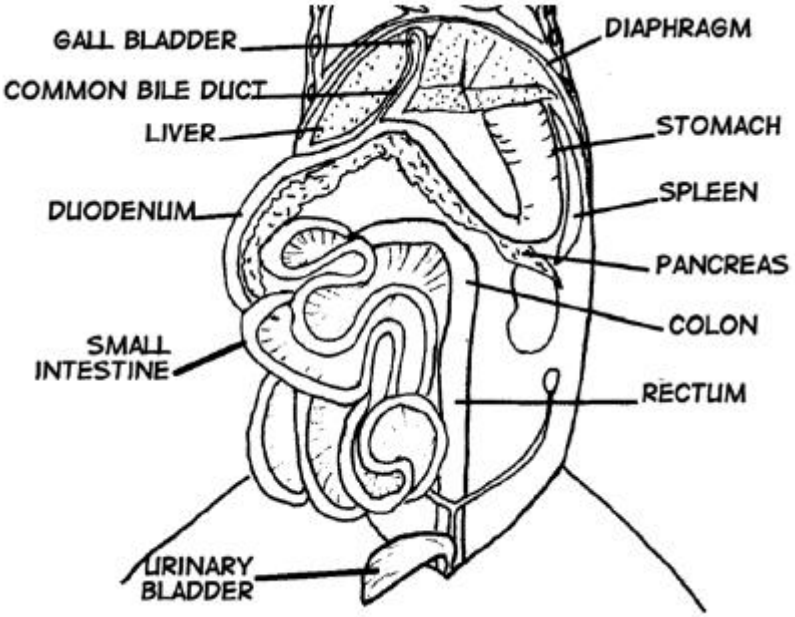


Diagram 5: Abdominal viscera extended

Identify the **small intestine**, which begins at the **pyloric sphincter**. In the mesentery of the first part of the small intestine lies the right limb of the **pancreas**. It is pinkish (brown in some minks) and rather loose in structure. The left limb lies near the stomach and extends to the spleen. The products of the pancreas (digestive enzymes) and of the liver (bile) are carried into the small intestine by a common duct system. Find the large **cystic duct** from the gall bladder and several **hepatic ducts** from the liver. These join to form the **common bile duct.** Bile passes from the liver to the gall bladder, where it is stored and concentrated. Eventually it is emptied into the small intestine. The common bile duct enters the small intestine near the pylorus, and its point of entry may be

marked internally by a small papilla. The two **pancreatic ducts**, one form each limb, join the common bile duct just before it enters the small intestine. Occasionally one of the pancreatic ducts will have a separate entry to the intestine.

The small intestine is divided into three segments: the **duodenum**, which begins at the pyloric sphincter, the **jejunum**, and the **ileum**. Identify the duodenum attached to the stomach. Identifying the jejunum and the ileum require histological (tissue) study. The ileum opens into the **large intestine**, or **colon**. There is no cecum, or pouch, developed at this point in the gut of the mink. The colon is not divisible into ascending, transverse, and descending segments as in many other mammals. It is instead a short descending tube that ends in the **rectum**.

Be sure you can identify the following parts:

Diaphragm	Intestines
Liver	Duodenum
Gall bladder	Pancreas
Stomach	Cystic duct
Greater omentum	Rectum
Gastric rugae	Spleen
Pyloric sphincter	Diaphragm

V. Heart

The circulatory system of the mink consists of **lymphatic ducts** and the **blood vascular system** (heart, arteries, veins, portal veins, and capillaries). The arteries and veins of your specimen should be injected with colored latex -- red for systemic arteries and blue for systemic veins. The hepatic portal system, if injected, should be yellow. If it is not injected, the vessels can be traced because the dark brown coagulated blood is visible through the thin walls. Use forceps and a blunt or flexible probe when tracing vessels.

Arteries carry blood from the heart to capillary beds in either the lungs or the rest of the body. Arterial blood is under high pressure, and the walls of arteries are thick. Veins carry blood from capillary beds back to the heart. Venous blood is under low pressure, and the walls of veins are thin. Portal veins carry blood from one capillary bed to another without passing through the heart.

Use Diagrams 6 and 7 to help you identify the structures in this section. Cut the pericardium and open the pericardial cavity. Note that the pericardium extends onto the great vessels connected to the heart and is reflected back on them and on the heart surface as the **epicardium**, or **visceral pericarium**. Cut the systemic aorta, the precava, the azygos vein, and the postcava. Refer to Drawings 2 and 3 to help you identify the blood vessels. Gently lift the heart outwards and cut the pulmonary arteries and veins as close to the lungs as possible. The heart can then be removed from the body. Remove the excess fat from the epicardium.

The **atria** lie towards the right side of the chest. The **ventricles** are drawn to a point, the **apex**, on the left side. Identify the left and right atria. The atria are separated externally from the ventricles by the deep **coronary sulcus**. Right and left ventricles are separated externally by a shallow **interventricular sulcus** in the musculature. Identify the stumps of all blood vessels leading to and from the heart.

The heart musculature has its own blood supply, the **coronary arteries**. These arteries come off the systemic aorta and run in the coronary sulcus. Branches run from the sulcus to the atria and down the ventricles to the apex, supplying the muscular heart wall. The heart muscle capillaries are drained by a number of **cardiac veins**. Those draining the ventricular wall run from the apex toward the atria and empty into the **coronary sinus** on the dorsal surface of the heart. The coronary sinus empties into the right atrium.

Diagram 6: Heart, Ventral View

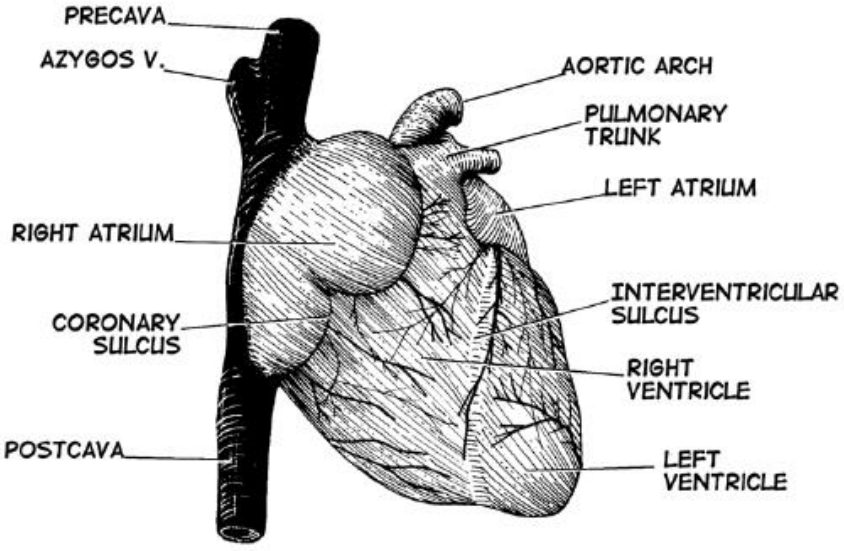
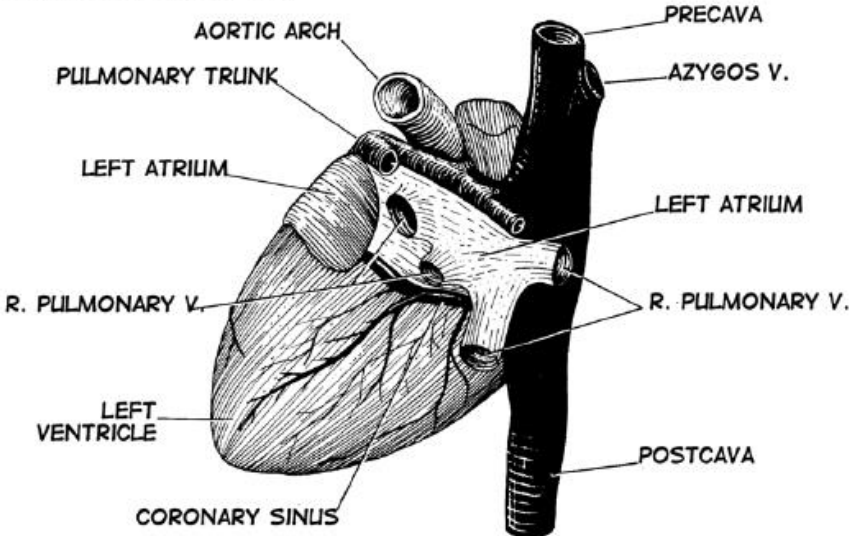


Diagram 7: Heart, Dorsal View



Place the heart between your fingers with the apex pointing up and the dorsal and ventral surfaces touching your fingers. Keeping this orientation, put the base of the heart (atria side) down on the dissecting tray. With your scalpel, section the heart by cutting lengthwise, between your fingers, from the apex to the base of the heart. Remove the coagulated blood and latex from the heart and wash out the cavities. Be especially careful around the valves. Identify the **right and left atria**, **right and left ventricles**, **bicuspid and tricuspid valves, precava, postcava, aortic arch, pulmonary trunk,** and **pulmonary veins**. Note the **chordae tendinae** and the **papillary muscles**. Note that the wall of the atrium is much thinner than the wall of the ventricle.

Be sure you can identify the following parts:

External View	Internal View	Attached Blood Vessels
R. atrium	R. atrium	Precava
L. atrium	L. atrium	Post cava
R. ventricle	R. ventricle	Aortic arch
L. ventricle	L. ventricle	Pulmonary trunk
Coronary arteries		Pulmonary veins
Cardiac veins		

VI. Arteries and Veins

Use Diagrams 8, 9, 10 and 11 to help you identify the blood vessels. Clean the vessels in the thoracic cavity. The systemic aorta curves dorsal as the **aortic arch** and then runs caudal as the **thoracic aorta**. Two major arterial trunks come off the arch of the aorta, the **brachiocephalic** and the **left subclavian**. The brachiocephalic gives off the **right internal thoracic artery** to the ventral chest and then divides into its three major branches, the **left** and **right common carotids** and the **right subclavian artery**.

Diagram 8:
Arteries of the Thorax and Neck

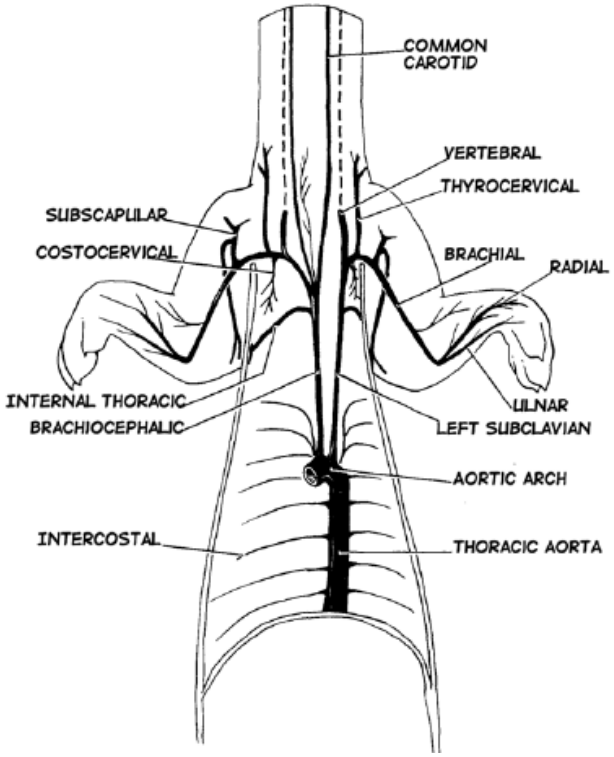
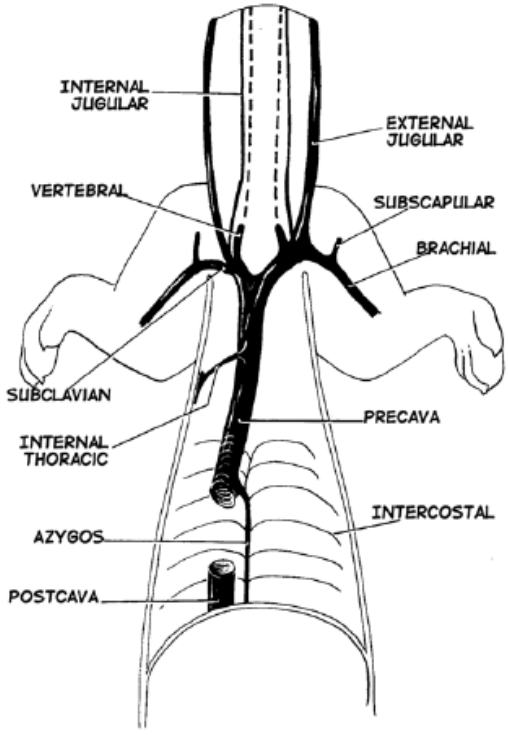


Diagram 9:
Veins of the Thorax and Neck



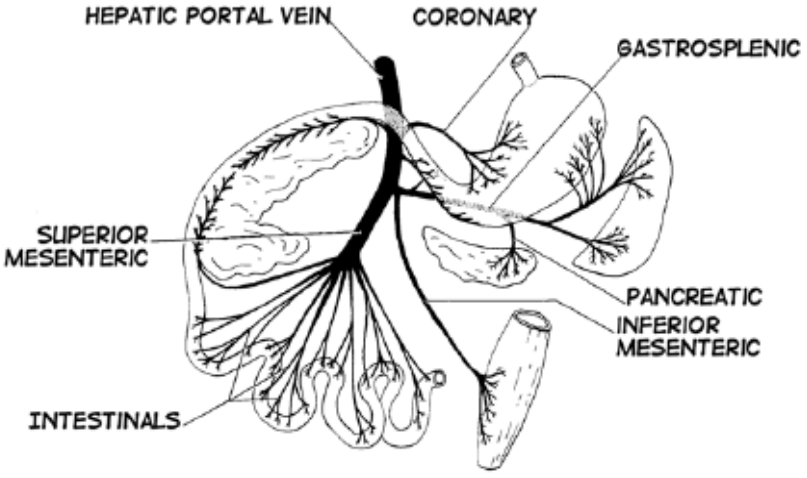
The systemic drainage of the front part of the body is collected in the **precava** (or anterior vena cava). It is formed by the fusion of the **right** and **left brachiocephalic veins**. Each of these receives blood from the **vertebral**, **internal jugular**, **external jugular,** and **subclavian veins**. The internal jugular vein runs alongside the common carotid artery, and the vertebral and subclavian veins are close to the arteries of the same names. In the thorax the precava also receives blood from a single **internal thoracic vein**, which drains from both sides of the ventral chest wall, and from the **azygos vein**.

Trace the **external jugular vein** and its tributary veins on the surface of the right side of the next and head. On the left side where the sternomastoid muscle has already been cut, locate the deeper vessels running alongside the trachea, the **internal jugular vein** and the **common carotid artery**. They run in a loose connective tissue sheath bound together with the vagus nerve. The internal jugular vein can be traced to its exit from the skull at the jugular foramen. It receives blood from sinuses in the skull and between the meninges of the brain.

Each common carotid artery gives off small branches to the esophagus and trachea and, just caudal to the origin of the diagastric muscle, divides into the **internal** and **external carotid arteries**.

In the abdominal cavity, first expose and study the **hepatic portal vein** and its tributaries. This system of veins drains capillaries in the walls of the gut and carries the blood to the sinuses of the liver. The hepatic portal vein is formed by the junction of three major tributaries, the **superior** and **inferior mesenteric veins** and the **gastrosplenic vein**.

Diagram 10: Hepatic portal vein and its branches

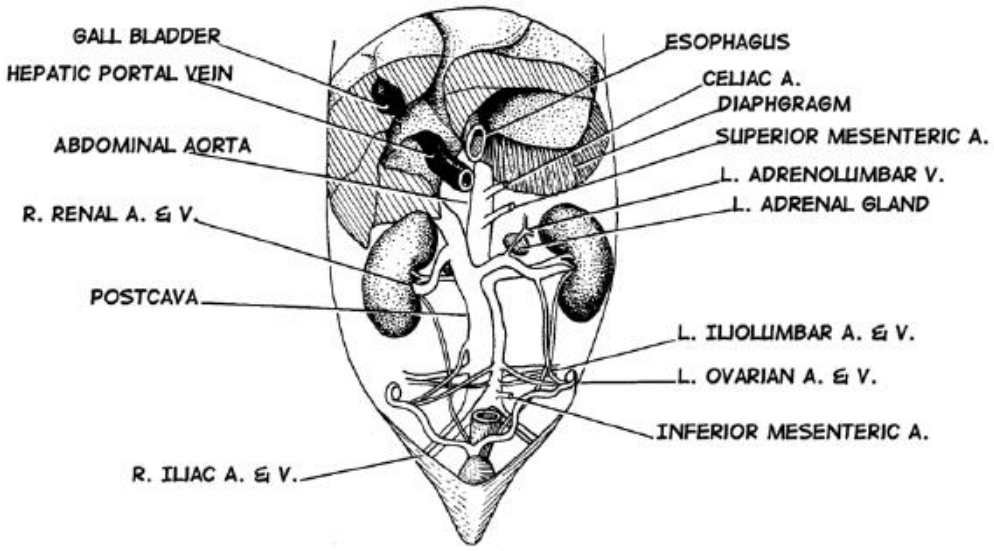


The liver has a dual blood supply. Blood in the hepatic portal vein is rich in nutrients freshly absorbed in the gut wall. Blood from the abdominal aorta (via a branch of the celiac artery) is rich in oxygen. The sinuses of the liver drain ultimately into the hepatic veins, which enter the postcava. The hepatic veins carry blood rich in waste materials and carbon dioxide. The hepatic veins may be found by cutting into the liver itself near the postcava.

The remaining vessels of the abdomen are the **abdominal aorta** and its arterial branches, and the **postcava** (posterior vena cava) and its tributaries. The abdominal aorta has three major branches in the gut, the **celiac** and the **superior** and **inferior mesenteric arteries**. The celiac artery splits into several branches, which supply the liver, stomach, spleen, duodenum, and part of the pancreas. The superior mesenteric artery supplies most of the remainder of the intestines and the

remainder of the pancreas. The inferior mesenteric artery supplies the lower part of the large intestine and the rectum.

Diagram 11: Arteries and veins of the abdomen



The other branches of the abdominal aorta are associated with tributaries of the postcava -- the **renal, adrenolumbar, iliolumbar, iliac**, and **caudal** vessels. The arteries to the gonads come off the abdominal aorta cranial to the iliolumbar branches -- **ovarian arteries** in the female and **spermatic arteries** in the male. Venous return from the gonads enters the postcava on the right side and the renal vein on the left.

Be sure you can identify the following parts:

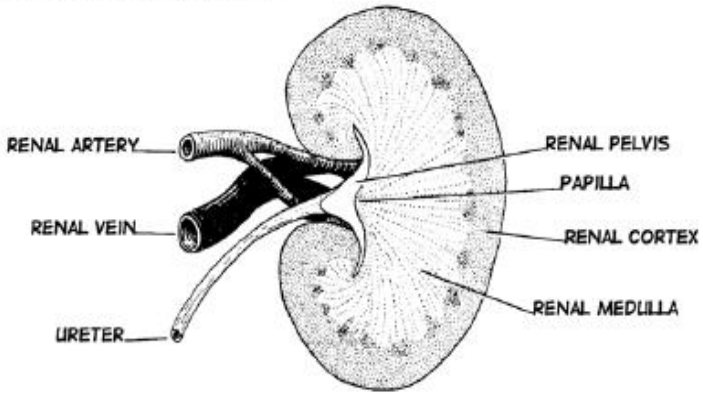
Arteries	Veins
Aortic arch	Precava
Thoracic aorta	Post cava
Brachiocephalic artery	Internal jugulars
Left subclavian artery	External jugulars
Common carotids	Subclavian veins
Abdominal aorta	Azygous vein
Renal artery	Hepatic portal vein
Iliac artery	Renal vein
	Iliac vein

VI. Excretory System

Use Diagram 12 to help you identify the structures in this section. Carefully remove the fat surrounding the kidneys and genital organs. Use forceps and a blunt probe. Save all the ducts and blood vessels. Expose the **kidneys**. They lie against the dorsal body wall and are covered by parietal peritoneum. The **adrenal glands** are small dark brown bodies lying in the fat medial to each kidney. The right adrenal gland lies dorsal to the right renal vein. Find and clean the **ureters, renal artery, renal vein** and trace them to their connections to the **urinary bladder**. The bladder is connected to the ventral body wall by a suspensory ligament. Urine passes from the kidneys to the bladder via the ureters and is stored there. The urine eventually passes from the bladder to the outside of the body through the **urethra**.

The kidney of the mink is bean-shaped, having a convex lateral border and an indentation, the **hilus**, medially. The ureter, renal artery, and renal vein enter the kidney at the hilus. Remove one kidney and slice it longitudinally in the frontal plane with your scalpel. Internally, two zones of tissue can be distinguished macroscopically -- the outer granular **cortex**, and the inner striated **medulla**. The glomeruli and capsules of the kidney tubules are in the cortex, and the loops of Henle and the collecting tubules are in the medulla. In the mink all collecting tubules converge at a single **papilla**, where the urine is emptied into a cavity, the **renal pelvis**. The renal pelvis is drained by the ureter.

Diagram 12: Kidney, frontal section



9. Be sure you can identify the following parts:

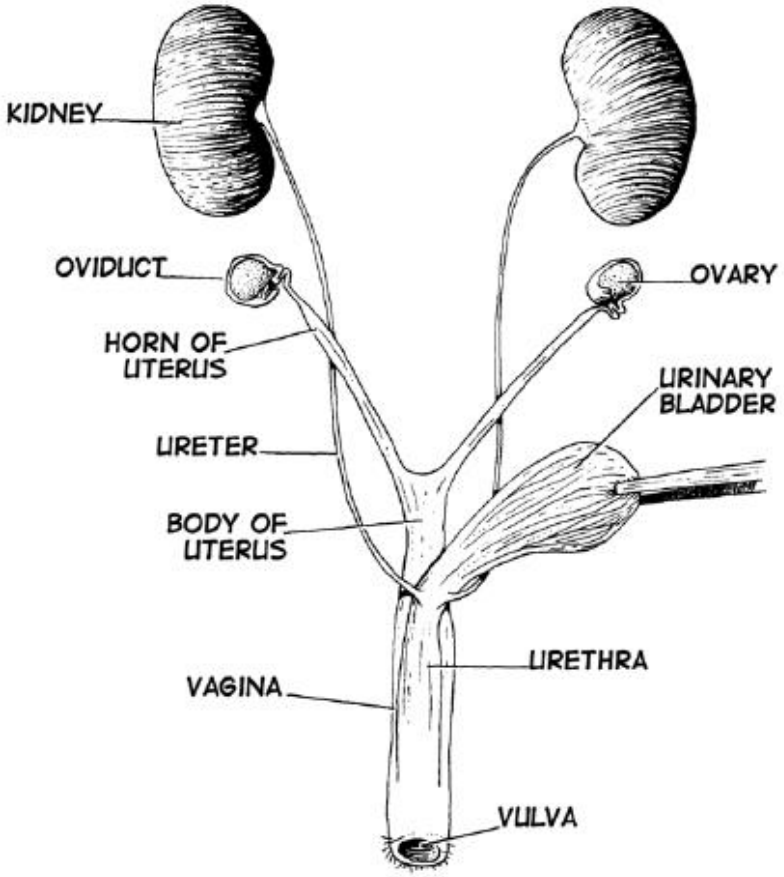
Kidney	Renal cortex
Ureter	Renal medulla
Urinary bladder	Renal pelvis
Renal vein	Renal artery

VIII. Reproductive System

Female Reproductive Tract

Use Diagram 13 to help you identify the structures in this section. Expose the **ovaries, oviducts**, and **uterus**. Size and morphology of these structures vary with the reproductive state of the animal. If your mink is a fall-killed young female that has never born kits, the uterus will be thread-like and the ovaries and oviducts very small and difficult to study in detail. The uterus of the mink is biocornuate, having two **horns** which meet dorsal to the urinary bladder to form the **body** of the uterus. Each horn is supported by a sheet of mesentery called the **broad ligament**.

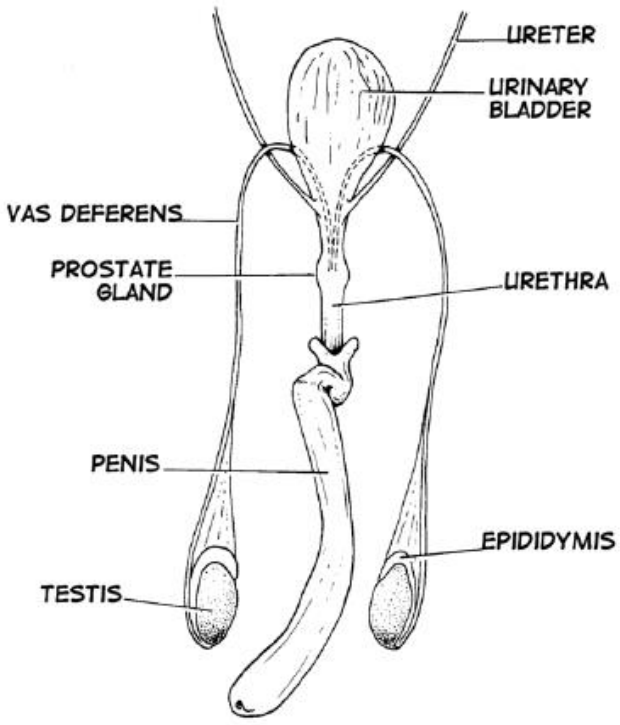
DIAGRAM 13: FEMALE URINARY & REPRODUCTIVE TRACTS



Male Reproductive Tract

Use Diagram 14 to help you identify the structures in this section. Find the **testicles** and lean them of fat. In the intact animal they are enclosed in a skin pouch, the **scrotum**, which is removed with the pelt. The tough sheath of the testicle is the **vaginal tunic**, an extension of the parietal peritoneum of the body cavity. Cut the tunic open and identify the **testis, epididymis,** and **vas deferens.** Sperm are produced in the testis, are stored in the epididymis, and eventually pass into the vas deferens. Trace the vas deferens to its entry into the abdominal cavity, over the ureter, and down the dorsal surface of the urinary bladder.

DIAGRAM 14: MALE URINARY & REPRODUCTIVE TRACTS



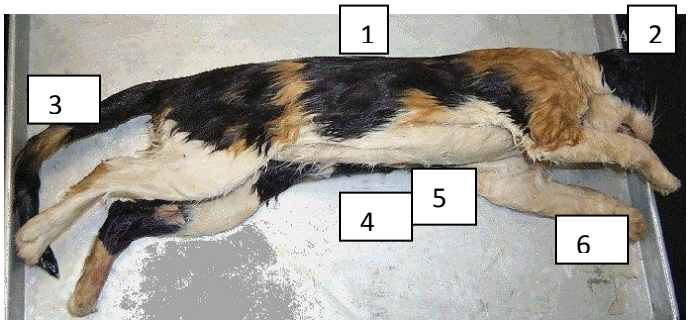
Be sure you can identify the following parts:

Female	Male
Ovaries	Testes
Horn of the uterus	Epididymis
Body of the uterus	Vas deferens
	Penis

Name _____ Date _____ Per _____

CAT DISSECTION DATA SHEETS

Day 1 - External Anatomy



Directional Terms

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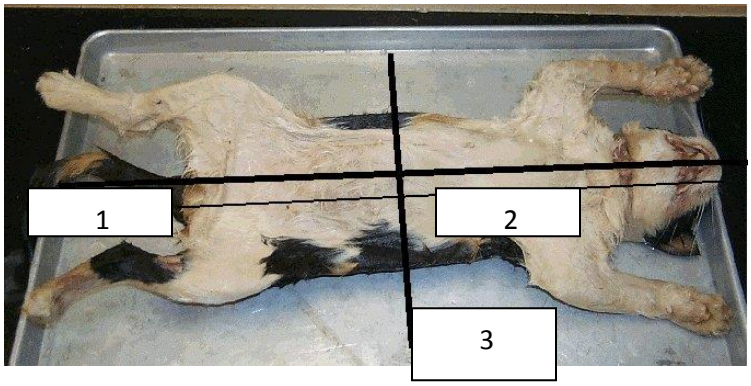
Planes of Division



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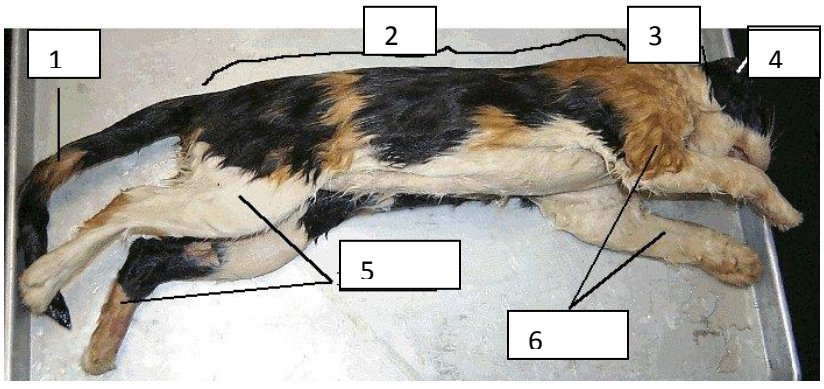

External Features

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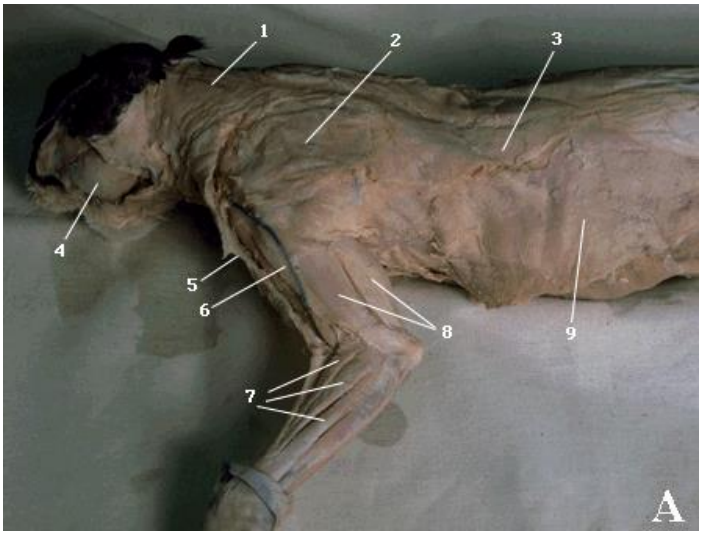
Day 2 – Muscular System



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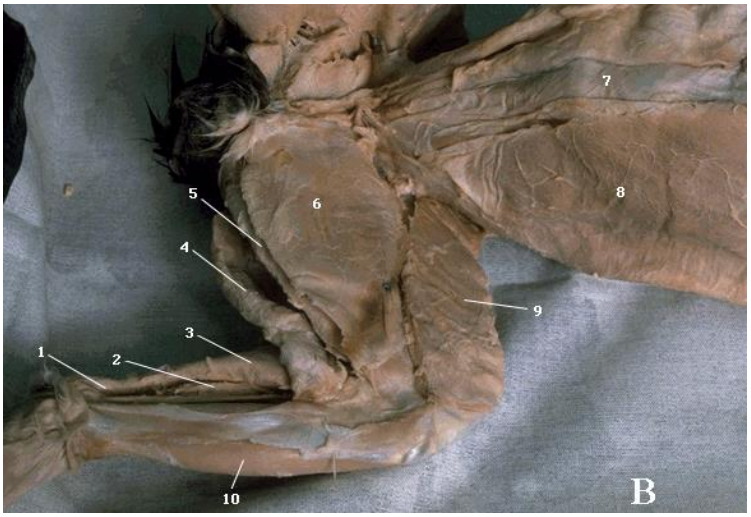

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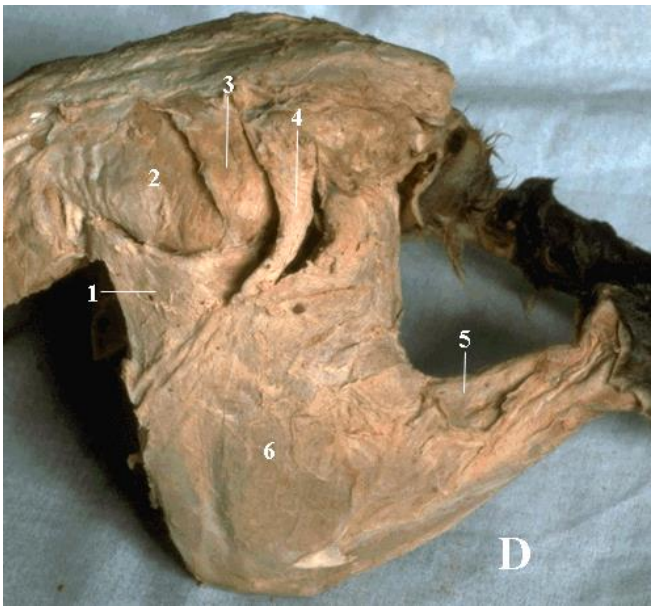

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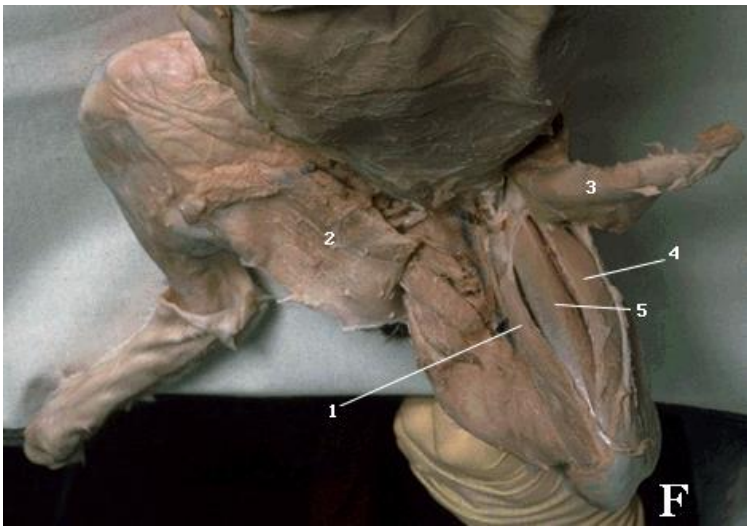

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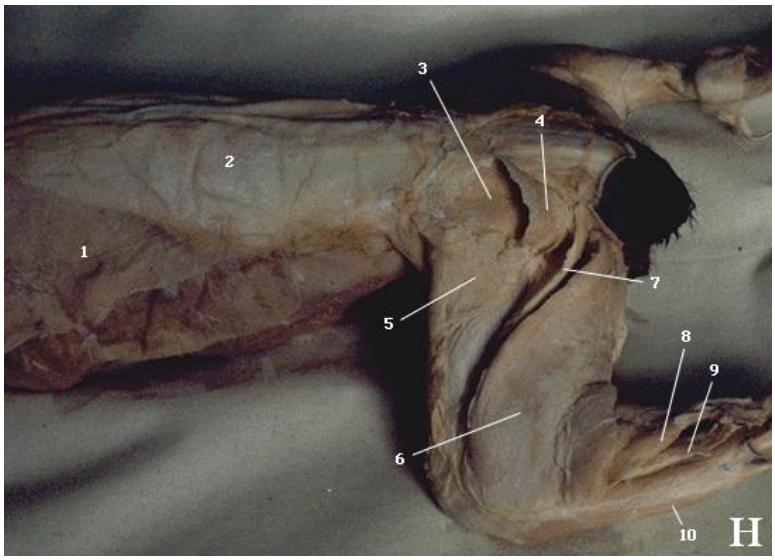

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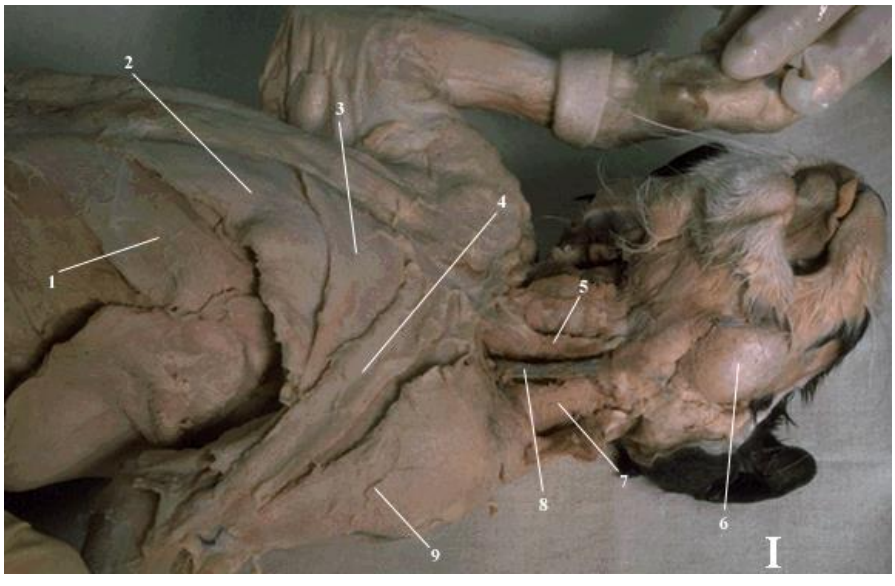

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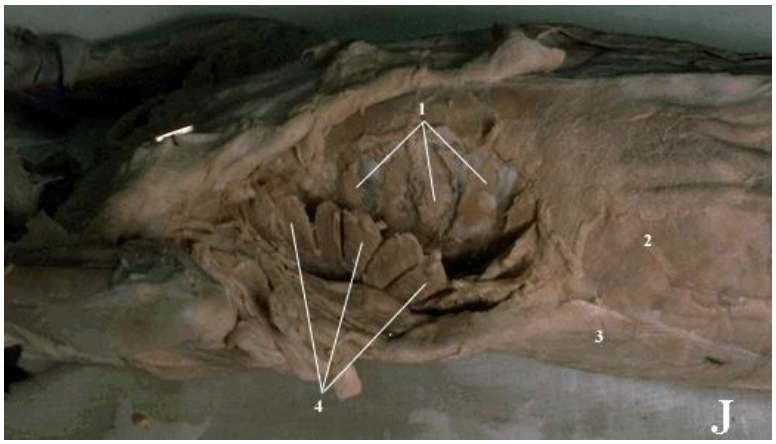

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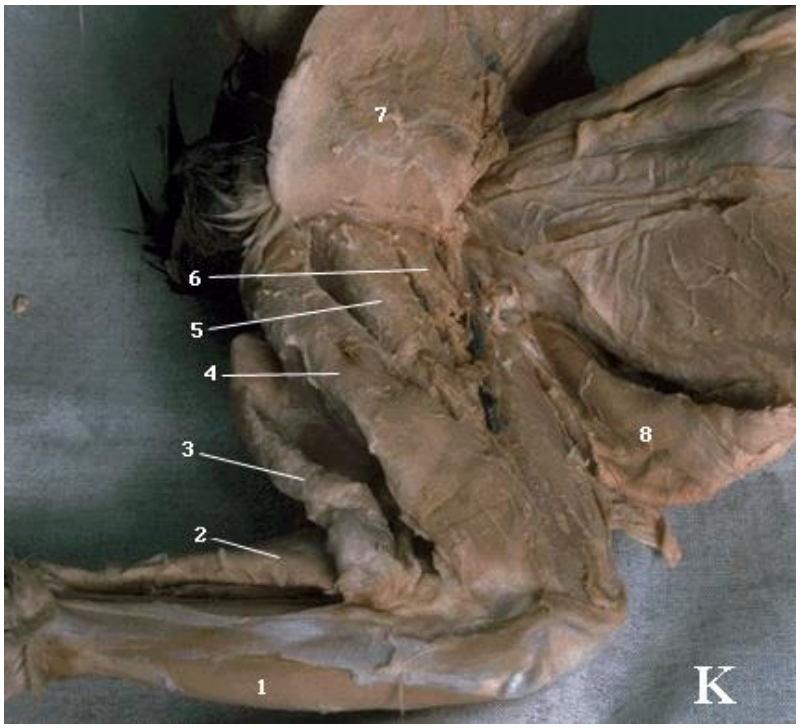

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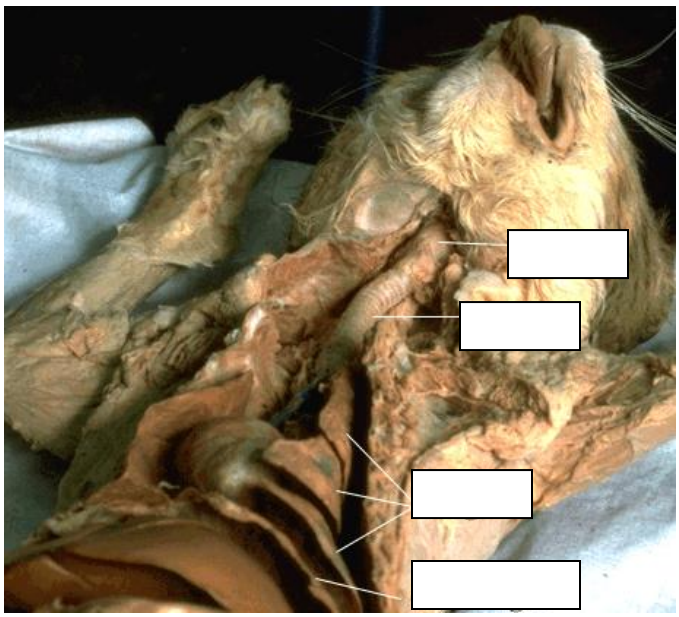
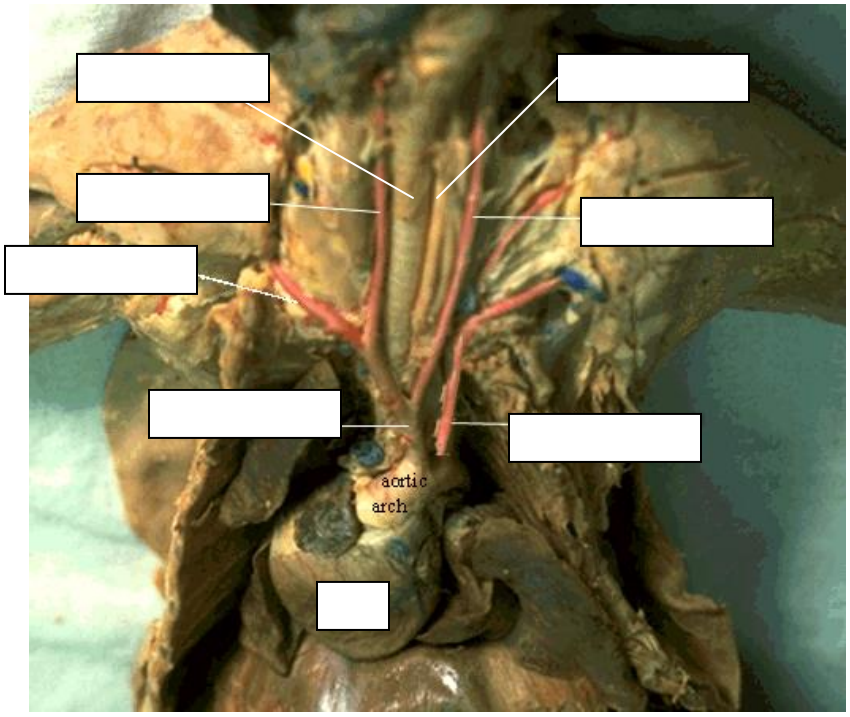
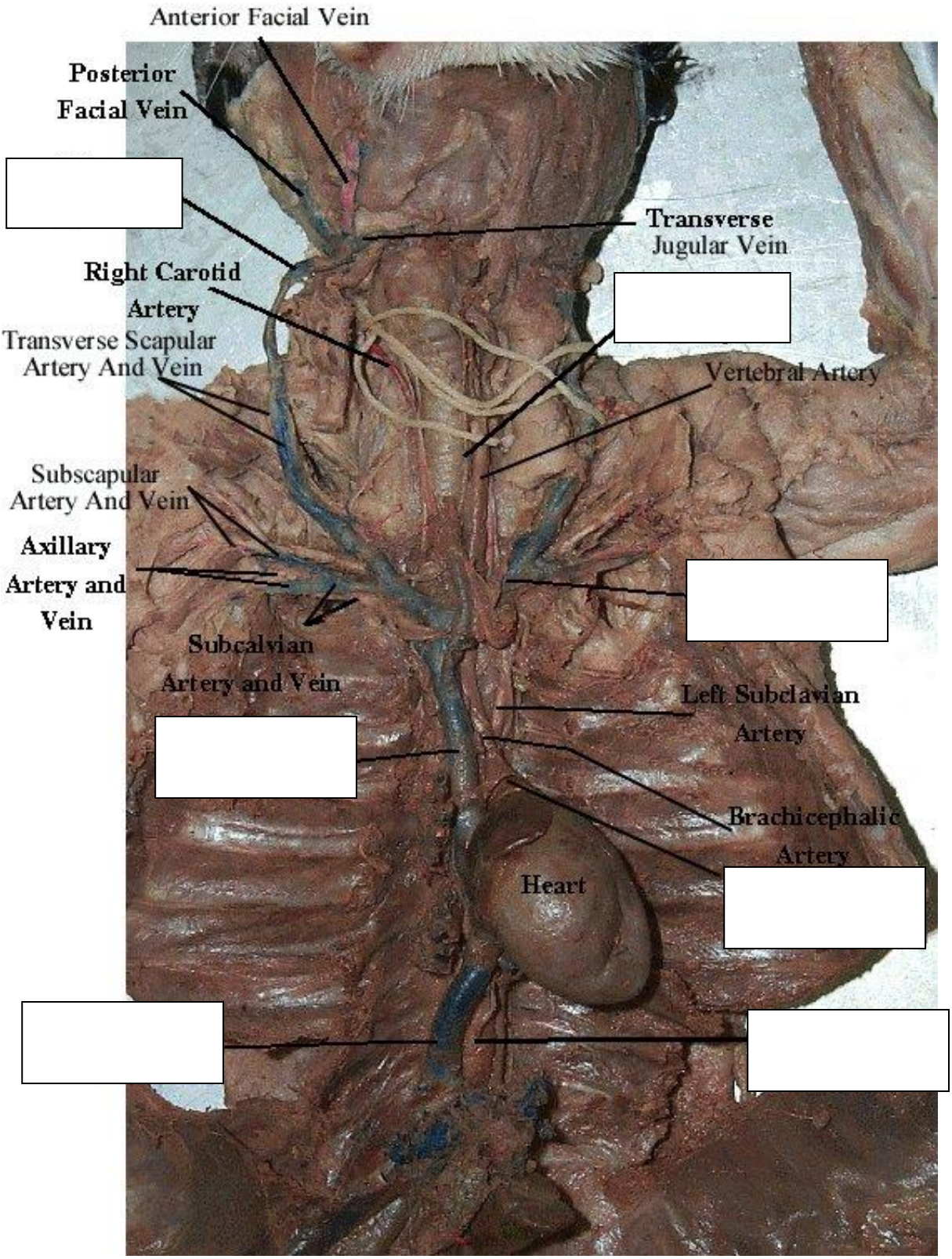
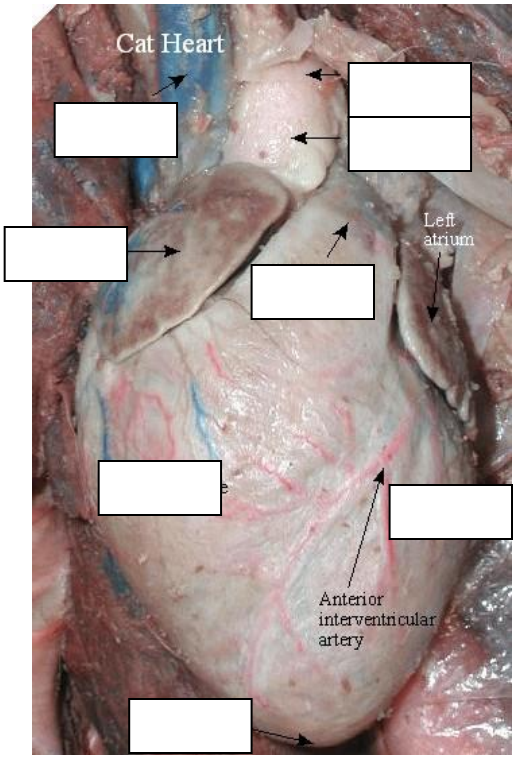
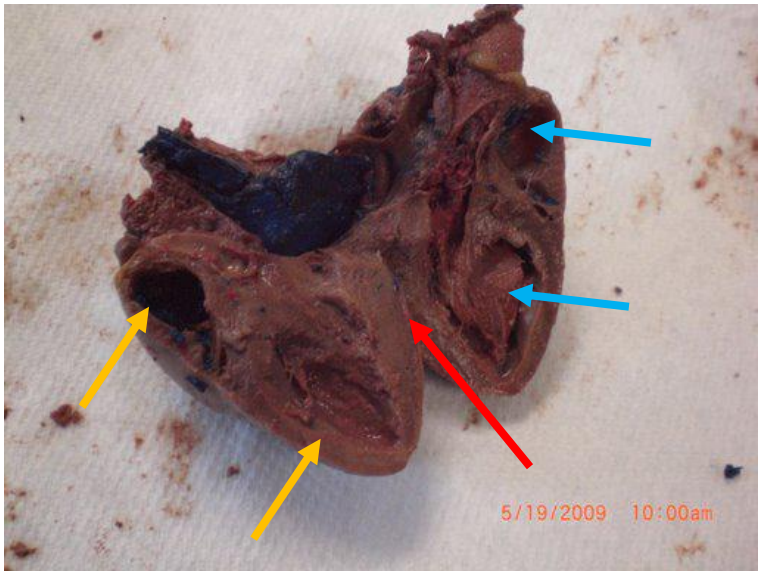
Day 3 – Circulatory and Respiratory Systems






Anterior Facial Vein
Posterior Facial Vein
Transverse Jugular Vein
Right Carotid Artery
Transverse Scapular Artery And Vein
Vertebral Artery
Subscapular Artery And Vein
Axillary Artery and Vein
Subcalvian Artery and Vein
Left Subclavian Artery
Brachicephalic Artery
Heart


Cat Heart
Left atrium
Anterior interventricular artery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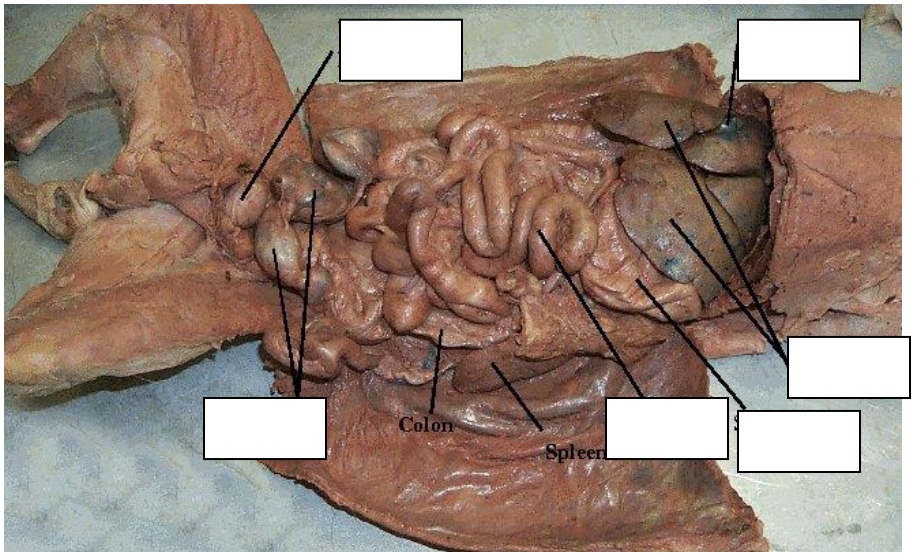
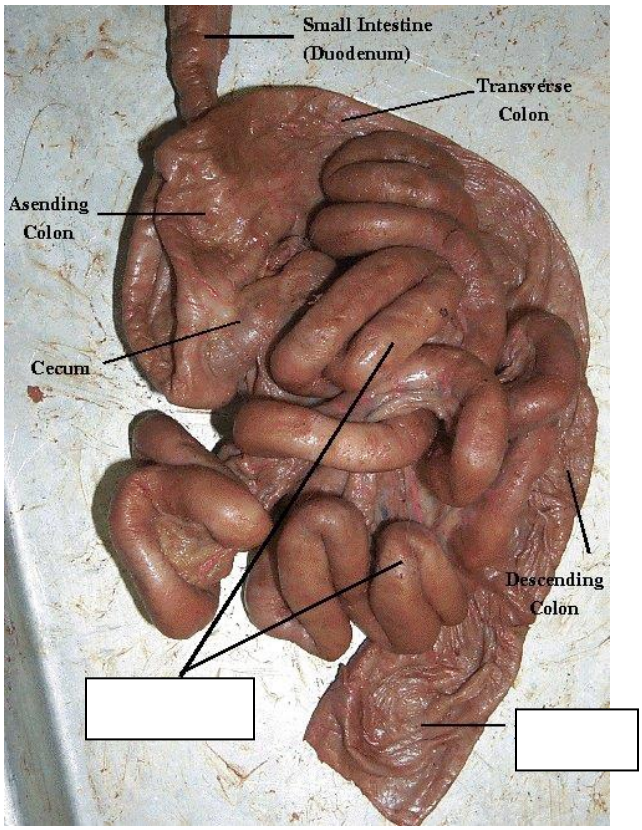
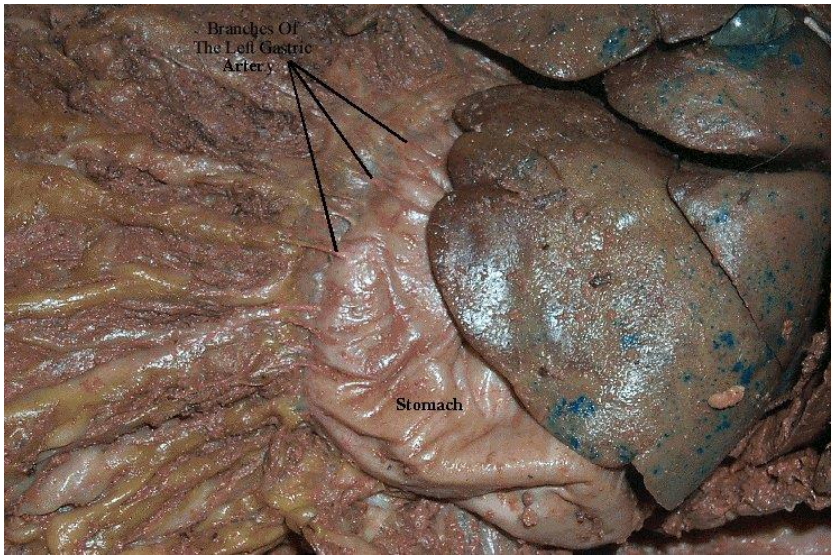
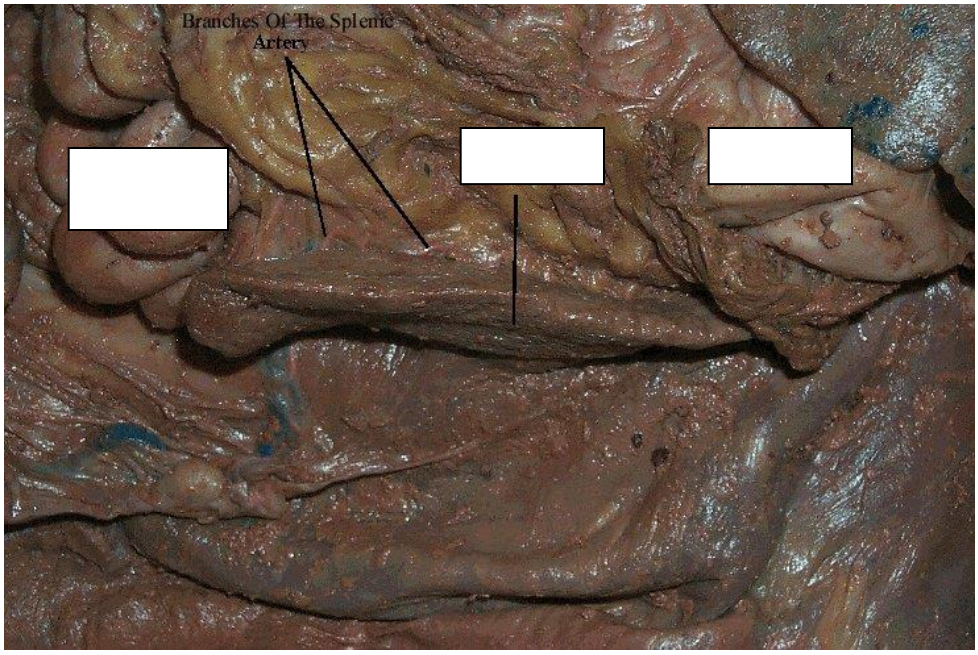
Day 4 –Digestive System









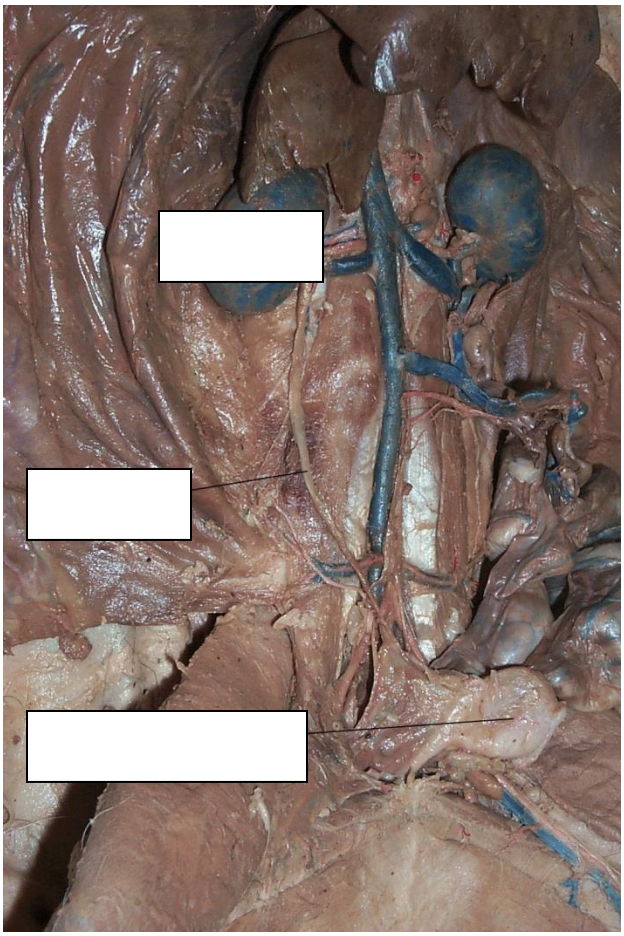
Length of Small Intestine: _____

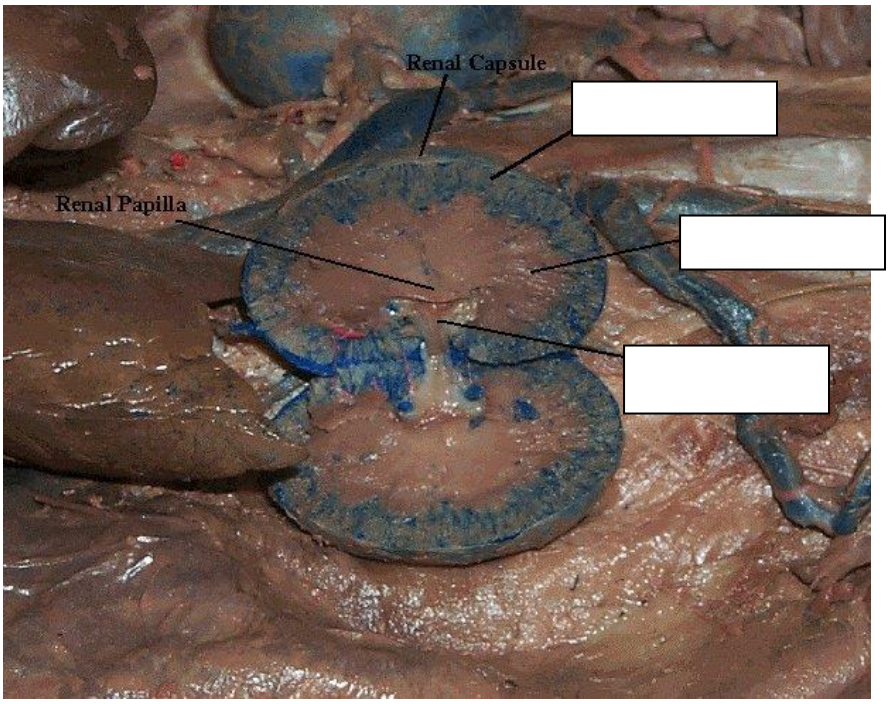
Length of Large Intestine: _____

The covering of the small intestine _____

Name _____ Date _____ Per _____

Day 5 –Urogenital System





NERVOUS SYSTEM LAB

Forbush High School
Anatomy and Physiology

Neuron Anatomy

Utilizing the neuron model, lecture notes and diagrams:

- Draw a typical motor neuron. Label and describe the primary function of the three parts listed.
    - Cell body
    - Dendrites
    - Axon

- Describe how a nerve impulse is transmitted from one neuron to another. Be sure to include the following terms:
    - Action potential
    - Synaptic knob
    - Synaptic cleft
    - Neurotransmitter
    - Receiving (postsynaptic) membrane

Neuron Classification

Utilizing your lecture notes and textbook:

- Describe the three classes of neurons based upon their function.

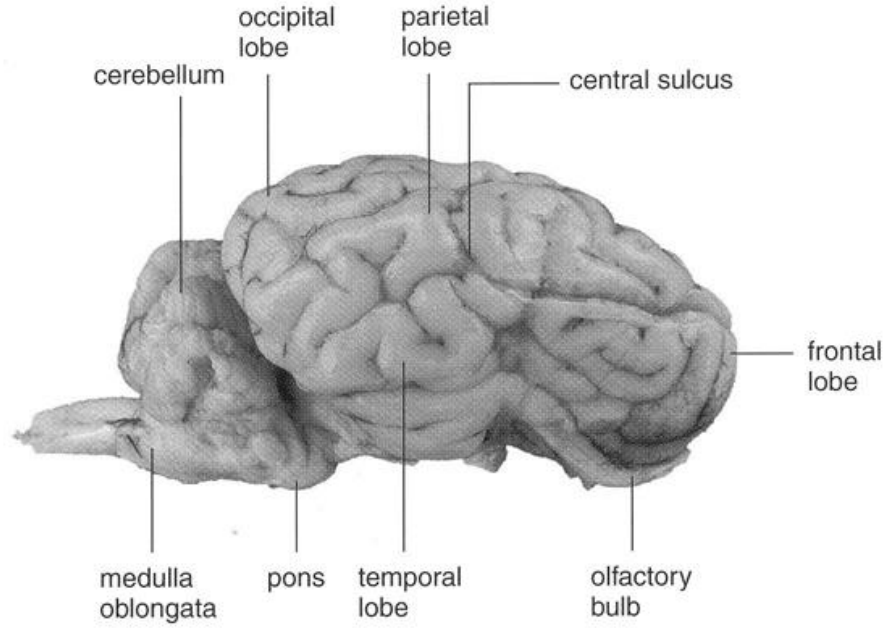
The Human Brain

Utilizing a brain model, textbook and your notes:

- Discuss the externally visible regions of the cerebral hemispheres, diencephalons, brain stem and cerebellum.
- Locate on a model and describe below the region of the cerebral hemisphere that controls each of the following functions:
    - Motor movement
    - Sensory perception
    - Sight
    - Reasoning
    - Hearing
    - Smell

SHEEP BRAIN DISSECTION
Obtain sheep brain, gloves, dissecting tray and instruments

Lateral view: View your sheep brain from the lateral aspect (from the side)



Lateral view

- Compare the various areas of the sheep brain (cerebrum, brain stem, cerebellum) to the human brain
    - which of these structures are larger in humans?
    - Locate the frontal, parietal, occipital and temporal lobes.
    - Locate the central sulcus. Which two lobes does it separate?

Dorsal view:

Place the sheep brain on the tray inferior surface down.

- Observe the pia mater (innermost meninge) extending down into the sulci/fissures on the superior and lateral surfaces of the brain.

- Cut through this meningeal tissue along the longitudinal fissure. Gently force the cerebral hemispheres apart laterally to expose the corpus callosum, the large fiber tract deep to the longitudinal fissure.

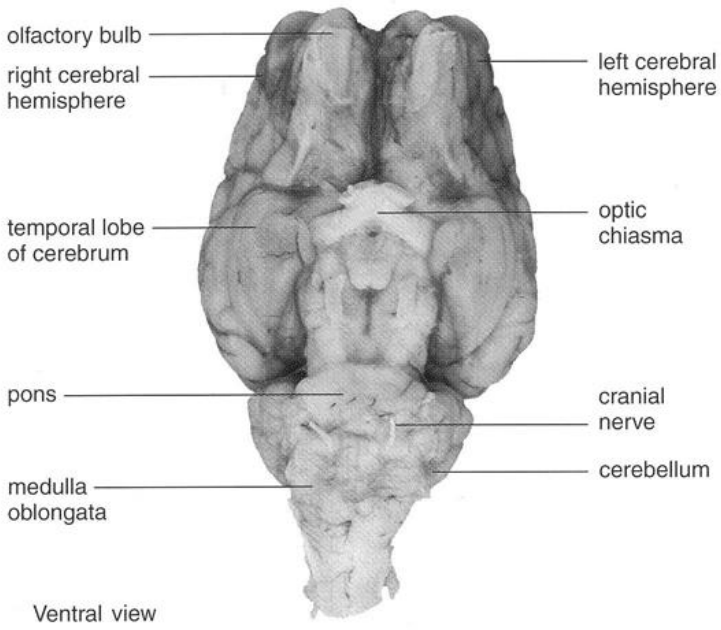
- Carefully dissect open some sulci. Note their depth compared to the longitudinal fissure.

- Examine the cerebellum. Note that in contrast to humans, it is not divided longitudinally.

Ventral view:

Turn the brain over and check out its inferior aspect

- **Olfactory bulbs:** Note the club-like olfactory bulbs on the inferior surface of the frontal lobes of the cerebral hemispheres.
- How does the size of these olfactory bulbs compare with those in humans? Is the sense of smell more important for food acquisition/protection in sheep or humans?



Optic Chiasm: Note the X-shaped structure.

- Locate the optic nerve - carries sensory impulses from the retina
- optic chiasm – site where fibers from each optic nerve cross over to the opposite side
- optic tracts - nerve posterior to the chiasm

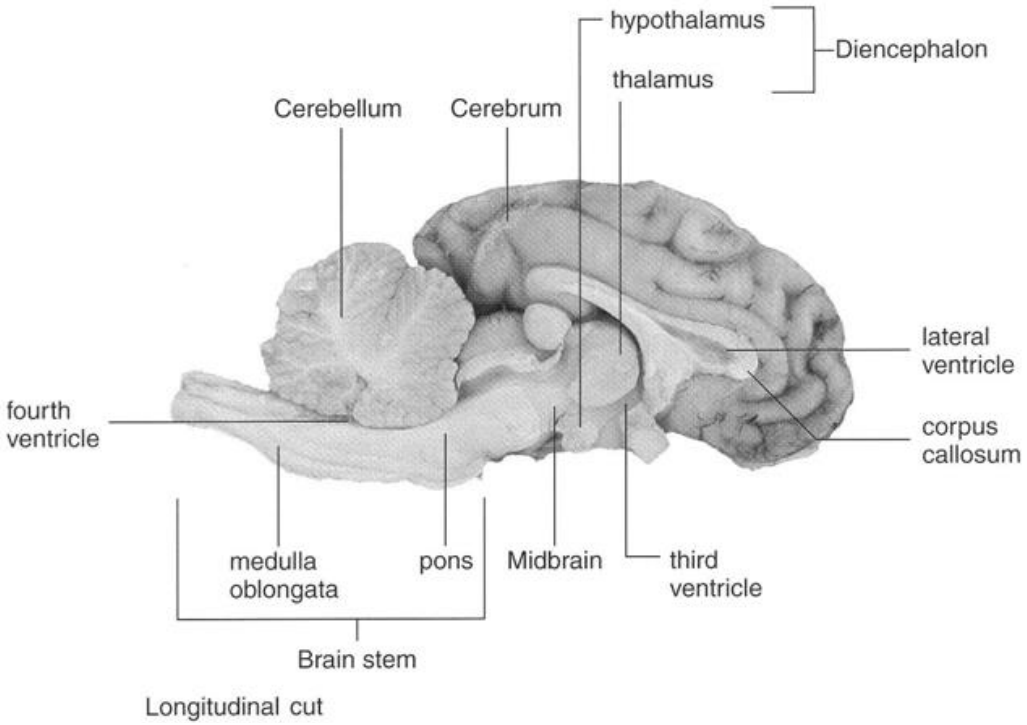
Pituitary: Stalk of the pituitary gland is posterior to the chiasm

- this structure may or may not be present

Brain Stem: Locate the midbrain, pons and medulla oblongata posterior to the chiasm

Internal structures: With the brain ventral side down, obtain the large knife and make a mid-sagittal cut long the longitudinal fissure and midline of the cerebellum creating equal left and right halves. Give one half of the brain to table without a specimen.

- **Diencephalon:** Identify the thalamus and hypothalamus
- **Brain Stem:** Locate the midbrain, pons and medulla oblongata
- **Cerebellum:** Notice the treelike arrangement of its white matter.



Dispose of your brain specimen as directed and return the dissection instruments back to the cart. Wash your desktop and your hands before leaving.

Spinal Cord

Utilizing a model or appropriate diagram of the spinal cord, identify and describe the functions of the following parts:

- Gray matter
- Dorsal root
- Dorsal root ganglion
- Ventral root
- Spinal nerves

The Reflex Arc

Identify and describe the function of each element of the reflex arc:

- Receptor
- Sensory neuron
- Interneuron
- Motor neuron
- Effector

Activities:

1. **Somatic Reflexes**

a) Patellar (knee-jerk) reflex
   i. Seat the subject on the lab bench with legs hanging free (or the knees crossed)
   ii. Tap the patellar ligament sharply with the reflex hammer just below the knee to elicit response.
   iii. Note: knee-jerk reflex assess the L2-L4 level of the spinal cord.

- Test both knees and record your observations.
- Which muscle contracted?

b) Achilles (ankle-jerk) reflex
   i. Remove your shoe.
   ii. Have your partner use one hand to dorsiflex your foot to increase tension on the gastrocnemius (calf) muscle.
   iii. Sharply tap the Achilles tendon with a reflex hammer.

- Note: ankle-jerk reflex assesses the first two sacral segments of the spinal cord.
  - What is the result?

2. **Autonomic Reflex**

- Pupillary reflexes
  - Obtain a flashlight
  - Conduct the test in an area where the lighting is relatively dim
  - Standing to the left of the subject, instruct him or her to view a distant object. Using a quick rising motion, shine the light into the right eye.
  - What is the pupillary response of the right eye with the introduction of light?
  - What is the pupillary response in the left eye when the light enters the right eye? (this is called a consensual response)

A Case Study on the Nervous System
Human Anatomy and Physiology

You are a neurologist at a major urban hospital. A 63 year-old stroke victim is brought to you for your neurological assessment. This patient suffered a stroke after several occlusions of branches of one of the cerebral arteries. A series of cognitive, sensory and motor tests reveal the following signs and symptoms.

The patient has completely lost the perception of the somatic senses (somatosensation) from the right side of his jaw, face and tongue. There is only minor diminishment in somatosensation from his right hand and lower arm. However, even though the patient recognizes he has an object in his right hand by touch, he has almost no ability to identify objects by touch when they are hidden from sight. Sensation in his left arm, torso and both legs is unaffected.

The patient experiences flacid paralysis in the muscles on the the right side of his jaw and face. Movements of his right hand are hesitant and uncoordinated - he can no longer play piano or type with his right hand. He can no longer move his right ring finger at all. Activity and coordination of other muscle groups appears normal.

The patient understands written and spoken words and can read and write normally. However, his speech is labored and his enunciation is severely impaired.

1. A stroke is a(n):

A. sudden, marked change in the pattern of electrical activity leading to abnormal involuntary movements and unusual sensations.
B. accumulation of abnormal intracellular deposits within neurons of the brain.
C. interruption of the blood supply to a portion of the brain.
D. sudden loss of synaptic connections between the neurons within a portion of the brain.

2. Which of the following pathological conditions could NOT have caused the stroke suffered by the patient?

A. ruptured aneurysm
B. atheriosclerosis
C. thrombus
D. embolism

3. Even though the death of neurons accompanies a stroke, a stroke patient may partially regain the cerebral function that was lost. This recovery is likely to involve the regeneration of neurons by cell division. True or false?

A. True
B. False

4. Loss of somatosensation on the right side of the patient's jaw, face and tongue indicates the loss of function in which lobe of the cerebrum?

A. frontal
B. parietal
C. temporal
D. occipital

5. Loss of the ability to interprete the kind of object present in his right hand by touch alone indicates damage to what area of the patient's cortex?

A. primary sensory area
B. sensory association area
C. motor association area
D. primary motor cortex

6. Loss of coordinated motor function in the right hand indicates the loss of function in which lobe of the patient's cerebrum?

A. frontal
B. parietal
C. temporal
D. occipital

7. Inability to move the right side of the jaw and face and right ring finger indicates damage to what area of the patient's cortex?

A. primary sensory area
B. sensory association area
C. motor association area
D. primary motor cortex

8. The difficulties that the patient has with language indicate which area of the cerebrum was damaged by the stroke?

A. general interpretive area
B. Wernicke's area
C. Broca's area
D. prefrontal cortex

9. Which hemisphere was damaged by the stroke?

A. right
B. left

10. Which area of the cerebrum was UNAFFECTED by the stroke? (circle the correct answer)

Visual cortex auditory cortex Wernicke's area Broca's area Angular gyrus

11. From the somatosensory and motor disruptions and the locations of the sensory and motor homunculi, which surface of the cerebral hemisphere within the areas responsible for sensation and motor control has been afflicted - lateral or medial?

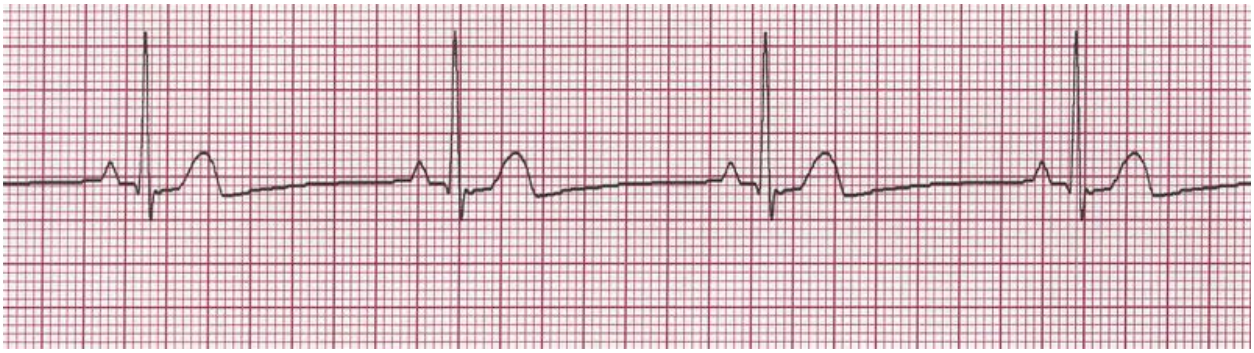
A. lateral
B. medial

12. From the location of the damaged areas of the cerebrum, which cerebral artery and its branches were occluded in the stroke?

A. anterior cerebral
B. middle cerebral
C. posterior cerebral
D. superior cerebellar

Using EKG's to Diagnose a Person:

1)

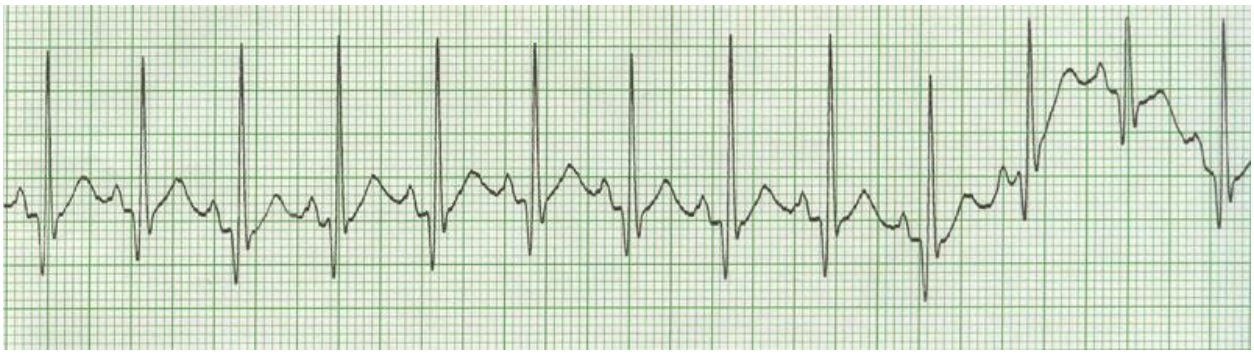


Diagnosis: (Be sure to include the hr and if rhythm is regular or irregular.)

2)

Diagnosis: (Be sure to include the hr and if rhythm is regular or irregular.)

3)

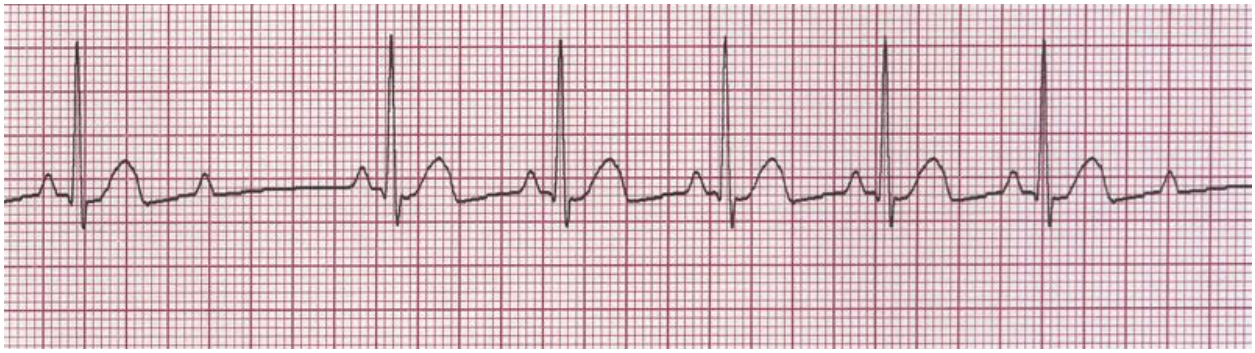


Diagnosis: (Be sure to include the hr and if rhythm is regular or irregular.)

4)

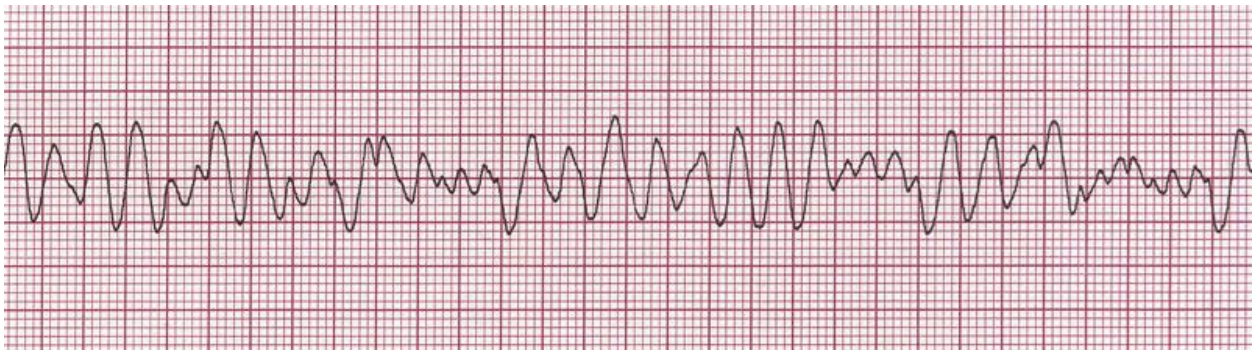
Diagnosis: (Be sure to include the hr and if rhythm is regular or irregular.)

5)



Diagnosis: (Be sure to include the hr and if rhythm is regular or irregular.)

6)



Diagnosis: (Be sure to include the hr and if rhythm is regular or irregular.)

PBL on: Respiratory/Chemistry

Oxygen: Inhalant for Women

Bethany, a 57-year-old woman with longstanding severe chronic bronchitis and asthma was admitted in respiratory failure. She had been out briskly walking on a cold morning, when she couldn't catch her breath. She collapsed on the roadside where she was seen by a neighbor, who immediately called 911.

Your first concern was to get some O_2 into her, so you bag her and order a blood gas test.

Her blood gasses were as follows:

pH……7.03
[H+]…….93 nmol/L (35-45)
pCO_2……10.5 kPa
actual bicarbonate……21 mmol/L
pO_2……..6.1 kPa

1. What is the acid/base disturbance?

2. What are the mechanisms involved?

3. How would you treat her?

4. What advice do you give Bethany to prevent this from happening again?