

I. The Vocabulary of Anatomy

Anatomical Position: When anatomists describe the location of one body structure with respect to another on a specimen, they imagine the body to be in a certain “reference position.” This is called anatomical position. It is described as follows: **the body standing erect, facing forward, feet together, toes pointed slightly apart, hands at one’s side, palms facing forward.** Once the body is in this position (or imagined to be in this position,) the positional terms given in the next section can be used correctly.

Positional Terms: These are terms used to describe the position of certain structures on the body. To familiarize yourself with the following positional terms, use each in a sentence describing structures of the human body.

Note: These are “relative terms.” This means that these words are usually used in relating the position of **one body structure to another.**

Ex. **Correct:** the nose is medial to the ears; **Incorrect:** the nose is medial

Anatomical Terminology: Position or Directional Terms

Dorsal
Ventral

*Anterior
*Posterior

*Superior
*Inferior

Medial
Lateral

Superficial
Deep

Proximal
Distal

Supine
Prone

Remember the hands, too!

Planes of Section:

Think about it, in a 3-dimensional world, how many different planes can you slice through an object?

Sagittal plane

Transverse Plane (cross section or x.s.)

Frontal Plane (coronal)

Left and Right: yours or the patient's?

Regional Terminology

Trunk

Anterior

Thoracic or Pectoral Region

Abdominal Region

Groin

Posterior

Costal region (rib)

Lumbar region

Gluteal region

Flank-side of trunk

Axilla- armpit

Arm

Brachium

Antebrachium

Cubital

Antecubital

Leg and Foot

Thigh

Calf

Popliteal region

Plantar surface

II. Bones of the Skeleton

Referring to your text, the articulated and disarticulated skeletons, locate the following bones, and describe their general location. You should be able to recognize them by themselves, as well as articulated (articulated = in position, touching its neighbors)

The Axial Skeleton

Skull (some of the major bones only)

Frontal

Parietal

Occipital

Temporal

Nasal

Zygomatic

Maxilla(e)

Mandible

Pectoral and Pelvic Girdles

Clavicle

Sternum

Vertebrae

Ribs

Scapula

Os Coxae

Ilium

Ischium

Pubis

Appendicular Skeleton

Humerus

Radius

Ulna

Carpals

Metacarpals

Phalanges

Femur

Patella

Tibia

Fibula

Tarsals

Metatarsals

Phalanges

Lab 1.2 Introduction to the Compound Light Microscope

Tutorial

In this lab, you will be expected to learn the names of each of the major parts of the scope, their function, and the proper handling and care of the scope. **You will be quizzed on this material.**

The light microscope used in our laboratory is an expensive, precision instrument that allows you to magnify a specimen up to a thousand times its original size. It is used by dozens of students each week. In the event that you find a scope damaged or nonfunctional, please let me know immediately.

Optics of the scope: A pair of lenses (the objective and the ocular) are used to progressively magnify the image of the specimen placed under the scope. Light rays coming from the light source below the specimen are collected, focused and successively refracted (bent) as they travel upward through the barrel of the scope toward your eyes, so that the image entering your eyes (at the pupil) is magnified many times over. This image is projected onto the retina at the back of your eyeball, the "screen" which contains receptors for light. In our class, we will generally use magnifications of 40 to 400 times (40-400 X.)

I. **Examining the parts of the scope.** Refer to the diagram that follows.

- Base: the supporting bottom portion of the scope
- Arm: the back support to the scope rising from the base. Often, the base and arm are attached by a joint that allows you to angle the position of the entire scope when it is placed on the countertop.
- Stage: This is the large, flat, horizontal surface on which a specimen (slide) is placed.

At this point, bring a scope from its storage cubby to your table being careful to carry the scope with one hand on the arm and the other hand under the base. Note that the scope is numbered at its base, and should be returned to the cubby of the same number. Place the scope on the tabletop, several inches in from the edge, with the arm closest to you and the stage pointed away from you. Remove the protective cover, and observe the remaining parts.

- Barrel (head): the large upper tube of the scope which extends from the arm.
- Oculars (eyepieces): these are the lenses which are located at the top of the scope. These lenses are the last to magnify the light coming up from the specimen. **Our scopes have two oculars, so we they are "binocular"** (as opposed to monocular scopes) which also means you should keep both eyes open when looking at a specimen. **The oculars should be fixed so that they are aimed toward you.** If not, inform your instructor. ***Do not rotate the barrel of the scope on your own, as there is a danger that the barrel may become dislodged in your hand.*** Note the magnification of the oculars by looking for the inscription on the side of one. This tells you how many times the image is magnified by this lens before entering your eye. What is its power? _____

Let's continue naming structures, starting at the base and moving upward:

- Light Source: Located on the base, this contains an incandescent light bulb which sends light upward to the specimen. Turn the light on by plugging in the scope, and then turning the on/off knob located at the front of the base. Turn the dial up to maximum power. Always turn it off before unplugging the scope.
- Iris Diaphragm: located under the stage, just below the condenser lens. This is simply an adjustable opening to control the amount of light that passes up through the specimen. The size of the opening can be increased or decreased, thereby allowing more or less light through, by sliding the lever bar you'll find

extending from it. Try moving the lever while looking through the oculars. Do you see a change in the amount of light coming to your eyes?

- **Condenser Lens:** located immediately under the stage, this lens can also be seen by peeking down through the hole in the stage. This lens focuses the random rays of light so that they move upward as a concentrated beam onto the specimen. The vertical position of this lens can be adjusted by carefully turning the silver knob extending to one side. When you think you've found it, gently rotate it and see if the condenser moves up and down. Note that during use of the scope, you'll generally want the condenser lens **as high as possible, but not so high that it will push up through the stage and into your specimen slide (\$\$\$\$)**
- **Stage clip with position knobs:** a spring clip that holds the slide in place. The clip should not be forced over the slide, but should only butt up alongside it. The position of the slide on the stage can then be controlled by rotating the two small concentric knobs extending to one side of the stage: one knob controls the forward/backward movement, the other controls the side to side movement of the specimen. Note that specimens appear to move in a direction opposite to their path when looking through the oculars.
- **Revolving Nosepiece with Objective Lenses:** these lenses are the first to magnify the specimen as light passes upward into the barrel of the scope. They are located just above the stage. They can be swivelled into vertical alignment using the nosepiece, and when a lens is in position you will feel it "click" into place. Look at the inscription on the side of each lens for its magnification. Note that the longer the lens, the higher its power. What are the magnifications available to you?
_____ (In our class, we will not be using the 100X objective since the optics of this lens requires us to place a drop of oil on the specimen slide.)

Compute the TOTAL MAGNIFICATION of any lens system by multiplying the nosepiece magnification by the ocular magnification. What are the various total magnifications available to you?

Our scopes are said to be "**parfocal**." This means that once you get the specimen in focus with any one objective lens, you can swivel another objective lens into place, and the specimen will not need refocusing. (It might need fine focusing though.) Be careful in doing this. Longer objective lenses may hit the slide if the specimen is unusually thick.

- **Coarse and Fine Focus Knobs:** these large concentric sets of knobs are found on both sides of the arm, just below the level of the stage, for your convenience (righties and lefties.) They allow you to focus the image to suit your vision. The larger course knob is used first to roughly focus the image, and only then is the fine adjustment knob used to fine tune. If you find yourself turning the fine focus knob more than 2-3 turns, you need to return to the coarse knob. These knobs allow you to focus by changing the distance between the specimen and the objective lens. *It is important that you see how this is done: on our scopes, rotating these knobs results in the stage moving up and down. **If this is not done carefully, you run the risk of driving the stage and slide (\$\$) into the objective lens (\$\$\$\$\$)***

To protect yourself from this costly error, use the following precaution: when raising the stage, keep your eyes off the oculars and your head positioned to the side of the scope and at the level of the stage. Elevate the stage until the slide comes very close but does not touch the objective lens. Then, only when lowering the stage, return your eyes to the oculars, being sure to slowly rotate the focus knobs in the opposite

direction, with the stage moving downward and away from the objective lens. As you do this, look for the point when the specimen is in sharpest focus.

Pause here:

review the names and functions of each of the above items with your lab partners before continuing.

II. Care of the Microscope

The following are some guidelines for proper use of the scope.

1. Before removing the scope from the storage cabinet, observe the position of the microscope in the cabinet - note that the number on the scope corresponds to the number of the cubby.
2. Carry the microscope with two hands - one supporting the base, and the other holding the arm.
3. Place the scope on a clean tabletop, directly in front of you so that the eyepieces are pointing toward you. Carefully remove the cover and unwrap the cord. Connect to electrical outlet and turn on the light source knob.
4. There should always be maximum distance between the stage and objective lens whenever the scope is not in use or is being stored. This is done by maximally lowering the stage using the coarse focus knob and by keeping the smallest objective lens in the vertical position. This is also the position used when changing slides.
5. When focusing, raise the stage **ONLY WHEN YOUR HEAD AND EYES ARE DIRECTLY ALONGSIDE THE STAGE** (as described in the previous section.) Only lower the stage away from the objective lens when your eyes are on the eyepieces.
6. Securing the electric cord requires folding the cord into a neat bundle alongside the scope. Never wrap the cord around the base of the scope.
7. Use **ONLY LENS PAPER**, (not towels, tissues or your shirt) to wipe lenses clean.

Putting the Scope to Bed. When you are finished using the scope, follow these steps IN THIS ORDER:

- a) Turn the nosepiece so that the lowest objective lens is in position.
- b) Maximally lower the stage.
- c) Remove the slide and replace in its proper slot and box.
- d) Turn off the light source with the on/off knob.
- e) Properly secure the cord.
- f) Cover the scope with its plastic cover.
- g) Return scope to its appropriate cubby with the arm facing outward and the secured cord properly tucked in alongside the base of the scope.

III. Troubleshooting or “How come I can’t see anything?”

Here are some solutions to the most common problems:

- **SEEING DOUBLE:** Be sure the distance between oculars is suited to the spacing of your eyes. Oculars can be adjusted by rotating the wheel located between these lenses. Oculars are correctly spaced when the visual fields (the circles of light each eye sees) fuse into one large circle of light. You should be looking through the scope with both eyes open, and not squinting or looking with one eye.
- **I SEE ONLY DARKNESS:** If you see no light in the visual field, check that the scope is plugged in, check the light source to see if the bulb is burned out and be sure objective lens is clicked into the vertical position.
- **I SEE SOMETHING, BUT ITS TOO DIM:** As you go to higher powers, you will require more light in your visual field. Check to see that the power switch which controls the light source is on maximum, that the iris

diaphragm is open wide, and, the most common error, that the condenser lens (below the stage) is raised as high as possible without touching the slide.

• **I CAN'T FOCUS BECAUSE THE FINE FOCUS KNOB WON'T TURN:** the fine focus knob can only make so many revolutions before it comes to the end of its thread. What has most likely happened is that someone before you has turned the fine focus knob too far instead of using the coarse knob. Try this: turn the fine focus knob back about 10 revolutions in the direction it will move. Then use the coarse knob to do most of the focusing work and only use the fine focus for the fine tuning.

Test Yourself !

1. To the right, draw a simple diagram of the scope used in our classroom. Label each part, and briefly describe its function.

2. Define the terms binocular and parfocal.

3. List the steps you would take, **in their proper sequence**,
a. in getting the scope and setting up your first slide
b. in focusing and then switching objectives
c. in removing your last slide, and preparing to put the scope away.

Lab 1.4 The Skull, Vertebrae

The Skull

Occipital Bone

- Lambdoidal suture (*don't pronounce the "d"*)
- Foramen magnum
- Occipital condyles
- Hypoglossal canal
- External occipital protuberance

Parietal bone

- Sagittal suture

Frontal bone

- Coronal suture
- Supraorbital foramen

Temporal bone

- Squamosal suture
- Petrous portion
- Squamous portion
- External auditory meatus
- Internal auditory meatus
- Mandibular fossa (glenoid)

Has 3 processes:

- Zygomatic process
- Styloid process
- Mastoid process

Has 3 Canals:

- Jugular Foramen
- Carotid foramen
- Stylomastoid foramen

Zygomatic bone

- Temporal Process

Sphenoid bone

Greater and lesser wings

Pterygoid process

Sella turcica

Has **Foramina**:

Foramen ovale

Foramen spinosum

Foramen rotundum

Foramen lacerum

Look inside the orbit for the:

Optic foramen

Superior and Inferior orbital fissures

Ethmoid bone

Cribriform plate

Perpendicular plate (part of Nasal septum)

Nasal conchae (recognize them, but not each one specifically)

Crista galli

Maxillary bone

Infraorbital foramen

Alveolar process

Palatine processes

Mandible

Body

Ramus

Coronoid process

Mandibular condyle

Mandibular notch

Mental foramen

Alveolar process

Lacrimal bone

Lacrimal duct

Nasal bone

Palatine bone

Vomer bone

Hyoid

Ear Bones- **Malleus, incus, stapes** (hammer, anvil, stirrup)

Anatomy of the Vertebrae

General Structures of a Single Vertebra:

Body

Centrum

Vertebral arch = neural arch

Pedicles

Laminae

Vertebral foramen

all form the Vertebral Canal

Has 7 Processes

Transverse process (2)

Superior and inferior articular processes (4 total)

Spinous process (1)

Intervertebral discs

Characteristics of the 7 Cervical Vertebrae

Bifid processes

1st C = **atlas**

No body

2nd C = **axis**

"universal joint"

Dens or odontoid process

Fatal whiplash

Thoracic Vertebrae - 12

All with ribs attached

Facets/demifacets

Difference from cervicals:

Lumbar Vertebrae- 5

Largest vertebrae, short stumpy projections

Sacrum - 5 fused vertebrae

Auricular surface

Sacroiliac joint

Sacral promontory

Anterior and posterior sacral foramina

Sacral spinal canal

Coccyx - 4or 5 fused rudimentary vertebrae

Lab 1.5 Pectoral Girdle and Upper Appendicular Skeleton

Clavicle

Sternal end
Acromial end

Scapula

Borders

Vertebral (medial)
Axillary (lateral)
Superior

Scapular Notch

Superior angle
Inferior angle

Glenoid cavity
Coracoid process
Acromion process

Scapular spine

Supraspinous fossa
Infraspinous fossa

Subscapular fossa

Ribs

True Ribs

False Ribs

Floating Ribs

Costal Cartilages

Head

Neck

Articular tubercle

Costal Angle

Body

Sternal End

Sternum

Manubrium

Jugular Notch

Sternal Angle

Clavicular Notches

Body

Xiphoid Process

Upper Appendage

Humerus

Head

Anatomical Neck

Surgical neck

Tubercles- greater, and lesser

Intertubercular sulcus

Deltoid tuberosity

Capitulum (lateral condyle)

Lateral epicondyle

Trochlea (medial condyle)

Medial epicondyle

Coronoid fossa

Olecranon fossa

Radius

Head

Neck

Radial tuberosity

Styloid process

Ulnar notch

Ulna

Olecranon process

Semilunar Notch (Trochlear notch)

Coronoid process

Radial notch

Head

Styloid process

Interosseus ligament

Note that these bones cross with pronation, but are parallel when the hand is supine

Hand

Carpals (mnemonic: physical therapy, lots of studying, time to come home)

Proximal row from lateral to medial:

scaphoid (Navicular), **lunate**, **triquetrum**, **pisiform**

Distal row, from lateral to medial

Trapezium, **trapezoid**, **capitate**, **hamate**

Metacarpals (1-5)

Digits (1-5)

Proximal, middle and distal phalanges (phalanx, singular)

1.6 Pelvic Girdle, Lower Appendage

Os Coxae

Ilium

Iliac crest
Sacroiliac joint
Acetabulum

Spines

Posterior superior iliac spine
Posterior inferior . . .
Anterior superior . . .
Anterior inferior. . .

Greater sciatic notch

Auricular surface

Ischium

Ischial spine
Lesser sciatic notch
Ischial tuberosity

Pubis

Pubic tubercle
Pubic symphysis

Obturator foramen

Differences between male and female pelvis

(Careful on these; not always reliable)

Male

Well marked ms attachment

Pubic arch < 90°

Round obturator foramen

Female

Indistinct ms attachment

Pubic arch > 90°

Oval obturator foramen

Lower Appendage

Femur

Head

Neck

Fovea capitis

Greater and lesser trochanter

Intertrochanteric crest

Intertrochanteric line

Gluteal tuberosity continues posteriorly as Linea aspera

Medial and lateral condyles

Medial and lateral epicondyles

Intercondylar fossa

Patellar surface

Tibia

Medial and lateral condyles

Intercondylar Eminence

Tibial tuberosity

Fibular Notch

Medial malleolus

Fibula

Head

Lateral malleolus

Patella

Base

Apex

Articular facets

Foot

Tarsals

Talus

Calcaneus

Navicular

Cuboid

Cuneiforms (3)

Metatarsals

Proximal, middle and distal phalanges, except hallux

Arches of the foot

Longitudinal

Transverse arch

1.7 Joints

The Shoulder Joint

Ball and Socket Joint

Articular cartilage

The Knee Joint

Hinge joint

Commonly injured

Semilunar cartilages or menisci

Lateral meniscus

Medial meniscus

Held together by the transverse ligament

Posterior cruciate ligament

Anterior cruciate ligament

Tibial collateral ligament

Fibular collateral ligament

Quadriceps tendon- holds kneecap in place-uppermost

Patellar ligament- lower

Bone List Items to identify in lab

Skull

- sutures
 - sagittal suture
 - coronal suture
 - lambdoidal suture
 - squamosal (squamous) suture
- parietal bone
- frontal bone
 - supraorbital foramen
- occipital bone
 - foramen magnum
 - occipital condyles
 - condylar fossa
 - hypoglossal canal
- temporal bone
 - external auditory meatus
 - internal auditory meatus
 - styloid (styloid) process
 - mastoid process
 - jugular foramen
 - carotid foramen
 - mandibular fossa
 - squamous portion
 - petrous portion
- zygomatic bone
- nasal bones
- lacrimal bones
- sphenoid bone
 - optic foramina
 - foramen rotundum
 - foramen ovale
 - foramen spinosum
 - sella turcica
 - pterygoid process
- ethmoid bone
 - crista galli
 - cribriform plate
 - olfactory foramina
 - perpendicular plate
- maxilla
 - infraorbital foramina
 - alveolar process
 - palatine process
- mandible
 - mandibular condyle
 - coronoid process
 - ramus
 - angle

- body
 - mental foramen
 - alveolar process
- foramen lacerum
- vomer
- palatine bones
 - palatine foramina
- ossicles (malleus, incus, stapes)
- hyoid bone
- Bones of the orbit
 - frontal
 - zygomatic
 - maxilla
 - lacrimal
 - sphenoid
 - ethmoid
 - palatine

Vertebrae, Ribs, and Sternum

- vertebrae
 - body
 - spinous process
 - transverse process
 - transverse foramen
 - pedicle
 - lamina
 - vertebral foramen
 - spinal canal
 - superior articular process
 - inferior articular process
- cervical vertebrae
 - C-1 (atlas)
 - C-2 (axis)
 - vertebral prominens
 - dens
- thoracic vertebrae
 - facet (and demi-facet)
- lumbar vertebrae
- sacrum
 - apex
 - base
 - anterior sacral foramina
 - posterior sacral foramina
 - sacral promintory
 - mid-sacral crest
 - sacral canal
 - auricular surface
 - ala
- coccyx
- ribs

- head
- neck
- tubercle
- body
- groove
- costal cartilage
- true rib
- false rib
- floating rib
- sternum
 - manubrium
 - jugular notch
 - clavicular notch
 - body
 - costal notches
 - xiphoid process

Appendicular Skeleton - Upper

- scapula
 - spine
 - superior border
 - lateral border (axillary border)
 - medial border (vertebral border)
 - inferior angle
 - supraspinous fossa
 - infraspinous fossa
 - acromion
 - glenoid fossa
 - coracoid process
 - subscapular fossa
- clavicle
 - sternal extremity (end)
 - acromial extremity (end)
 - conoid tubercle
- humerus
 - head
 - anatomical neck
 - surgical neck
 - deltoid tuberosity
 - greater tubercle
 - lesser tubercle
 - intertubercular sulcus
 - lateral epicondyle
 - medial epicondyle
 - capitulum
 - trochlea
 - radial fossa
 - coronoid fossa
 - olecranon fossa
- ulna

- trochlear notch (semilunar notch)
- olecranon
- coronoid process
- radial notch
- styloid process
- radius
 - head
 - neck
 - tuberosity
 - styloid process
 - ulnar notch
- carpals
 - navicular (scaphoid)
 - lunate
 - triangular (triquetral)
 - pisiform
 - greater multangular (trapezium)
 - multangular (trapezoid)
 - capitate
 - hamate
- metacarpals I, II, III, IV, V
- phalanges

Appendicular Skeleton - Lower

- ilium
 - iliac crest
 - anterior superior iliac spine
 - anterior inferior iliac spine
 - posterior superior iliac spine
 - posterior inferior iliac spine
 - iliac fossa
 - greater sciatic notch
 - auricular surface
- ischium
 - ischial spine
 - lesser sciatic notch
 - ischial tuberosity
- pubis
 - pubic crest
 - pubic symphysis (symphysis pubis)
- coxal bones - general
 - obturator foramen
 - acetabulum
 - pelvic brim
 - true pelvis
 - false pelvis
- femur
 - head
 - neck
 - greater trochanter

- lesser trochanter
- linea aspera
- lateral condyle
- medial condyle
- intercondylar fossa
- patellar surface
- fovea capitis
- tibia
 - lateral condyle
 - medial condyle
 - tibial tuberosity
 - intercondylar eminence
 - medial malleolus
 - fibular notch
- fibula
 - head
 - lateral malleolus
- tarsals
 - talus
 - calcaneus
 - navicular (scaphoid)
 - cuboid
 - medial cuneiform (cuneiform I)
 - intermediate cuneiform (cuneiform II)
 - lateral cuneiform (cuneiform III)
- metatarsals I, II, III, IV, V
- phalanges (sing. phalanx)

The Knee

- patella
- patellar ligament
- quadriceps tendon
- lateral collateral ligament (fibular collateral ligament)
- medial collateral ligament (tibial collateral ligament)
- lateral meniscus
- medial meniscus
- anterior cruciate ligament (ACL)
- posterior cruciate ligament (PCL)