INTRODUCTION
Preface

The next paragraph was the original introduction to the lab manual that was created in 1999 by the TAs mentioned below. Prior to this time the lab manual had existed as a series of handouts that I had created and modified over the years. This group of TAs did a nice job of formatting it and organizing it into a booklet with additional information to help students maximize their preparation for lab, to help them come away with a series of strong learning objectives to study for the material they cover in the laboratory.

Original Preface

After teaching Mark Nielsen’s Advanced Anatomy course last year, we realized that the laboratory part of the course could be organized a little better. Lauren Zollinger, Josh Jones, Susan McLaughlin and I thought it would be best to have a lab manual that clearly outlined the structures students need to learn and how to prepare for lab. Our goal is to help every student learn the form and function of the all the anatomy that Mark teaches in lecture. This is the first printing of the laboratory manual, so we are excited to improve upon it with your feedback. Again, we would appreciate your help in making this book better so that the class continues to improve.

Dave Gardner

Preface 2013

Now in 2013, the lab manual has undergone a significant makeover. We have striven to make changes that will allow the manual to complement the lecture book, reflect current anatomical terms as found in Terminologia Anatomica, and include all structures to make you well-rounded and educated anatomists. We are passionate about anatomy, teaching and learning, and hope that this manual will be a useful tool this semester.

Jackie Bohn, Ben Chou, Sarah Hudson, Ryan Watkins

Over the years I have been able to work with many, many great teaching assistants. Each of these individuals have wanted to make a difference and improve the course, while also helping the students learn the most they possibly can in the advanced anatomy course. I have helped with the final layout of the manual, and I hope the hard work the teaching assistants have put into this helps you with the lab.

Mark Nielsen
January 2013
**Anatomy Foundation**

Much of the information that you will learn in both lecture and lab in advanced human anatomy requires that you have a strong foundation knowledge of anatomy from my human anatomy course. There are a few things that you should review and be able to identify on your own in the first one or two weeks of lab:

1. All of the muscles in the trunk and limbs (including the hand and foot)
2. All of the bones of the articulated cranium
3. The anatomy of the nervous system covered in my human anatomy course

Relearning, or refreshing your knowledge of, this material will also be a big help on the midterm lecture tests. It takes a little time and work, but without a good foundation, building more knowledge is impossible. The following atlases are excellent resources to help you study anatomical structures, which you well learn about in lecture and see in the lab:

1. Netter’s Atlas of Human Anatomy 5th edition by Frank Netter
2. Thieme Atlas of Anatomy by Gilroy, et. al
3. Atlas of Human Anatomy by Nielsen and Miller

**Expectations**

This is a 5000 level class; therefore, more is expected of you than in Human Anatomy (Bio 2325). That doesn't necessarily mean that you’re expected to stockpile more information than in the other class. It means that you want to be here to learn anatomy. We expect you to put more time and work into it. We expect you to enjoy it. If you do put work into it, we’ll guarantee that you’ll have no regrets at the end of the semester. The following are our expectations:

1. **Know all of the material taught in Mark Nielsen's Human Anatomy course.** We will build upon your prior anatomy knowledge in lecture and lab, and we assume that you have a solid foundation in anatomy.
2. **Come to lab prepared.** The more prepared you are for lab, the more you will learn and understand while in lab. You can do this by reviewing the anatomy from lecture that will be covered in the lab, and also by studying photos and drawings in the recommended atlases.
3. **Use the lab.** Set aside a time every week when you can come to office hours in the lab to review. The time spent in lab will not be sufficient to learn all that is covered in each lab. You will need to spend extra time reinforcing the information that you are exposed to in the labs. It is your responsibility to know all structures listed in the lab manual.
4. **Use all the resources available.** The TAs are passionate about anatomy and excited to help you learn more. Don't hesitate to ask them questions. Netter’s Atlas of Human Anatomy is a powerful resource that can help you to succeed in this course. Additionally, Mark and Shawn's Atlas of Human Anatomy, Thieme Atlas of Head and Neuroanatomy, and Gray's Anatomy are great resources.
5. **Think.** This course requires you to think critically. Be prepared to ask “why” and “how” and get excited about the learning process. You are going to become a great thinker!
The Practical Exams

There will be a quiz and three practical exams – a skull practicum, a midterm practicum, and a final practicum. The first two will take place during a rotation of the day’s lab. The final practicum will take up the whole lab time during the last week of labs.

<table>
<thead>
<tr>
<th>Material Covered</th>
<th>Number of Questions (points)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slide Show Quiz on Skull Bones</td>
<td>All skull bones</td>
<td>10 questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 points</td>
</tr>
<tr>
<td>Skull Practicum</td>
<td>All skull bones (articulated and disarticulated skulls, sutures, landmarks, and foramina)</td>
<td>20 questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 points</td>
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<tr>
<td>Midterm Practicum</td>
<td>All structures from Labs 1-6 and corresponding lecture information (excluding skull structures)</td>
<td>20 questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 points</td>
</tr>
<tr>
<td>Final Practicum</td>
<td>All structures from Labs 1-10 and corresponding lecture information</td>
<td>75 questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 bonus questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75 points with 5 bonus points</td>
</tr>
</tbody>
</table>

Disclaimer: The Advanced Anatomy practical exams are different than the Bio 2325 exams – they are much more fun!

We reserve the right to probe structures not only from your structures to identify list for each lab, but structures learned in the Human Anatomy (Bio 2325) course as well as structures discussed in Mark’s Advanced Anatomy lectures. In addition, we’ll ask conceptual questions about a probed part instead of just asking you to name it (i.e. From what branchial arch is this muscle derived? or What spinal levels innervate this muscle?).

Lastly, we will use some parts that you have never seen before in lab. Thus, it pays to learn the anatomy and not just the part.

Care of Skulls

We are lucky to have human skulls to study in the lab. We’d like to keep it that way for future students. Skulls are fragile and very expensive to replace, so we’ve made a few rules to maintain their good condition:

1. Do not remove skulls from lab.
2. Probe the skulls only with a wooden probe or a thin, metal wire. The wires are located with the skulls and the wooden probes are in the first drawer on your left in the parts room.
3. Never use a pen or pencil to probe the skulls!!

4. Do not pick up or carry the skulls by placing your fingers in the orbits to hold the skull! Carry the skull with both hands and do not try to carry more than one skull at a time.

5. Skull calvaria and mandibles can fall off easily – be careful!

6. When studying the skull, place a yoga mat beneath it.

7. Always return the skulls, yoga mats, and your wooden or wire probes back to their appropriate homes.

8. The disarticulated skulls (the one in the green box) and the “exploded skull” are especially fragile. Please be extra careful handling these rare pieces.

**Care of Cadaver Parts**

Unlike the Human Anatomy (Bio 2325) class, you will be allowed and encouraged to go into the cadaver room to study cadaver prossections during office hours. This is a privilege; therefore, this opportunity requires you to be responsible.

Cadavers are expensive and an unbelievable amount of time goes into preparing the prossections, and you have the opportunity to work with some incredible dissections.

If a part is ruined (a nerve or vessel torn, a muscle ripped, etc.), it is possible that it cannot be replaced without money and hours of dissection time. That means that other students will suffer the consequences of one person’s carelessness. Here are the lab rules and some guidelines to keep these parts in good condition so that we can have a quality lab experience:

1. Keep the parts organized. Boxes and bags are labeled. If you take something out of a container see that it is returned to the same container. Place parts carefully in their container – avoid stacking parts on each other and make sure the lids snap shut. Never leave a part out.

2. Use the trays in the cadaver room for moving the cadaver parts to the main lab. Be sure to clean the tray with the yellow soap above the sink, dry it, and replace it after you’re done.

3. There are metal probes in the first drawer on your left when you walk into the parts room. Use them to point out a structure (your probe should be a few millimeters away from the structure at all times). Do not hook, rub, or poke structures! It is unnecessary and you will ruin the delicate structures!

4. Do not use wooden probes on soft tissue pieces.

5. Use the phenoxyethanol (in the clear spray bottles above the sink) to keep the parts moist while you are looking at them. Spray them every few minutes – you can never keep them too moist! When you put the part back in its zip lock bag, spray it again along with all the other parts in the container.

6. Clean the desk you used with the yellow soap and a sponge when you're done.

7. Resources such as Netter’s Atlas are available in the office for your use, however they cannot leave the lab. Please don’t handle them with dirty cadaver hands and keep them away from the phenoxyethanol spray.
**Problem Sets**

There will be eight problem sets throughout the semester each worth 5 points. Your best references are your knowledge of anatomy, your peers, and your anatomy books. **Searching the internet for answers is highly discouraged and will not help you in your learning process.**

The following procedures should be used when writing up the answers to the problem sets:

Begin by listing the relevant known facts that apply to the problem. This list should be a columnar list of sentences. It should not be a paragraph. The known facts can be obtained from the problem itself and from your knowledge of anatomy. Do not make any assumptions; use only the information presented in the problem.

The known facts should be followed with a logical list of intermediate conclusions that are supported by the known facts.

Use of simple diagrams is recommended.

Your work should be clearly presented and organized.

The grading of the problem set will be as follows:

One point will be given for having a list of clearly stated, relevant facts. The list should contain anatomical knowledge related to the information presented in the problem.

One point will be given if the intermediate conclusions are clearly supported by the relevant known facts.

Two points will be given for a worthy effort, even if you go off track. That is, if you have known facts and conclusions organized.

One point will be given for arriving at a solid answer or diagnosis. This is the most parsimonious solution supported by the summary of the related known facts. The answer should also include further tests that could help substantiate the diagnosis.

**Sample Problem Set**

Below is an example of the format and process you should follow to answer the problem set questions. It shows your thought process in a logical sequence. Always start by making a list of the known facts pertinent to the question. Then relate how these “knowns” are important in leading to a diagnosis or answer to the problem. You want to arrive at a conclusion in the most parsimonious way, that is, with the least amount of assumptions. Note: You will not get full credit for the problem set if you merely suggest the possible answer and diagnosis, you must list the knowns and show the logical progression as to how you arrived at your conclusion.

**Question:**

While working at the emergency room you examine a child with a large laceration medial to the olecranon. Upon examination you find that her wrist is slightly deviated toward the radius and she is unable to flex the distal interphalangeal joints on both her ring and little fingers. Using your knowledge of anatomy explain how you would pinpoint the lesion.
Start by listing known facts from the information you get from the problem, then expand on those knowns.

**Knowns**

1. Slight radial deviation of wrist suggests that ulnar deviation is not totally functional and cannot strike a balance with the radial deviators.
2. Flexion of the distal interphalangeal joints is performed by the flexor digitorum profundus.
3. The flexor digitorum profundus is innervated by both the median and ulnar nerves.
4. The ulnar nerve innervates the ulnar half of this muscle. The tendons that attach to the ring and little fingers (usually).
5. The ulnar nerve also innervates the flexor carpi ulnaris, an ulnar deviator of the wrist. This, however, is not the only ulnar deviator of the wrist.
6. The ulnar nerve is superficial in a groove posterior to the medial epicondyle of the humerus, corresponding to the location of the laceration.
7. The cutaneous field of the ulnar nerve is the skin on palmar and dorsal surfaces of the hypothenar region and ring and little fingers.

Next formulate a logical list of intermediate conclusions that are supported by the known facts (if applicable.)

**Intermediate Conclusions**

1. Slight radial deviation of the wrist suggests that ulnar deviation is not totally functional and cannot strike a balance with the radial deviators.
2. Damage to the ulnar nerve could cause the paralysis of the ulnar half of the flexor digitorum profundus and flexor carpi ulnaris muscles.

Now that you have described your “knowns” and intermediate conclusions, diagnose the lesion and clearly explain all manifestations mentioned in the problem. You should also describe any further tests you might perform to further solidify your diagnosis.

**Answer**

Based on the inability to flex the distal interphalangeal joints of the two digits on the ulnar side of the hand, the lesion must involve damage to the ulnar nerve. This nerve's location posterior to the medial epicondyle corresponds to the sight of injury. The slight radial deviation results from paralysis of the flexor carpi ulnaris, an ulnar deviator. The reason the wrist exhibits only a slight radial deviation is because the extensor carpi ulnaris, another ulnar deviator, is still functional and helps somewhat counterbalance the three radial deviators - the flexor carpi radialis, extensor carpi radialis longus, and extensor carpi radialis brevis. To further substantiate damage to the ulnar nerve a pinprick test should be used to determine cutaneous sensation. The prediction is that there is loss of cutaneous sensation in the ulnar cutaneous field (draw a picture to demonstrate).
OBJECTIVES

Rotation 1: Somitic Muscles of the head
Rotation 2: Branchial Arch Anatomy
Rotation 3: Branchial Arch Anatomy
Rotation 4: Hypaxial/Epaxial Muscles

PREPARATION

Advanced Anatomy Lecture Manual
Pages: 37-73


Pages: 15, 18, 25-29, 47, 52-60, 63, 67, 68, 77-79, 83, 84, 92-96, 168-172, 244, 367

Pages: 15, 18, 25-30, 48-50, 57-59, 64-70, 77-86, 171-177, 246, 365

Thieme Head & Neuroanatomy
Pages: 32-33, 44-53, 73, 98, 103, 105, 108, 112, 125, 134, 140, 144, 156-169
**Structures to Identify**

### Hypaxial Muscles

Subvertebral Musculature
- Longus Colli
- Longus Capitis
- Rectus Capitis Anterior

Lateral Musculature-Internal Layer
- Anterior Scalene
- Intertransversarii Cervicis Anteriores
- Intertransversarii Lumbarum Anterioris Lateralis

Lateral Musculature-Middle Layer
- Middle Scalene
- Rectus Capitis Lateralis
- Intertransversarii Cervicis Posteriore Lower Lateralis
- Intertransversarii Lumbarum Posteriore Lower Lateralis
- Cremaster

Lateral Musculature-External Layer
- Posterior Scalene

Ventral Musculature
- Sternohyoid
- Sternothyroid
- Thyrohyoid
- Geniohyoid
- Omohyoid
- Pyramidalis

*Note that this list of hypaxial muscles only includes the hypaxial muscles that you never got to see in the Biology 2325 - Human Anatomy course. You should also know all the hypaxial muscles that you learned in that course. We will not cover those in the lab, so it would be wise to review these during the office hour times in the lab.

### Epaxial Muscles

Superficial Series - Splenius Group
- Splenius Capitis
- Splenius Cervicis

Superficial Series - Erector Spinae Group
- Iliocostalis: Lumborum, Thoracis, Cervicis
- Longissimus: Thoracis, Cervicis, Capitis
- Spinalis: Thoracis, Cervicis, Capitis

Deep Series - Transversospinalis Group
- Semispinalis: Cervicis, Capitis
- Multifidus: Lumborum, Thoracis, Cervicis
- Multifidus: Laminar Fibers
- Rotatores: Longus, Brevis

Deep Series - Intervertebral Group
- Interspinales
- Levatores Costarum: Longus, Brevis
- Intertransversarii Cervicis Posterior Medialis
- Intertransversarii Thoraics
- Intertransversarii Lumbarum Medials

Deep Series - Suboccipital Muscles
- Rectus Capitis Posterior Major
- Rectus Capitis Posterior Minor
- Obliquus Capitis Inferior
- Obliquus Capitis Superior
Branchial Arches-Skeletal Derivatives
First Arch
○ Incus
○ Malleus
○ Sphenomandibular Ligament

Second Arch
○ Stapes
○ Styloid Process
○ Stylohyoid Ligament
○ Hyoid Bone-Lesser Cornu
○ Hyoid Bone-Cranial Part of Body

Third Arch
○ Hyoid Bone-Greater Cornu
○ Hyoid Bone-Inferior Part of Body

Forth through Sixth Arches
○ Thyroid Cartilage
○ Cricoid Cartilage
○ Arytenoid Cartilages
○ Vocal Ligament

Somitic Head Muscles
Prechordal Mesoderm
○ Superior Rectus
○ Inferior Rectus
○ Medial Rectus
○ Lateral Rectus
○ Levator Palpebrae Superioris
○ Superior Oblique
○ Inferior Oblique

Occipital Somites 2 to 4
Extrinsic Tongue Muscles
○ Styloglossus
○ Genioglossus
○ Hyoglossus

Intrinsic Tongue Muscles
○ Superior Longitudinal
○ Transverse
○ Inferior Longitudinal
○ Vertical

Branchial Arches-Muscular Components
First Arch
○ Temporalis
○ Masseter
○ Medial Pterygoid
○ Lateral Pterygoid
○ Anterior Digastricus
○ Mylohyoid
○ Tensor Veli Palatini
○ Tensor Tympani

Second Arch
○ Muscles of Facial Expression From Biol-2315
○ Corrugator Superficial
○ Platysma
○ Buccinator
○ Posterior Digastricus
○ Auricularis Anterior
○ Auricularis Superior
○ Auricularis Posterior
○ Occipitofrontalis
○ Temporoparietalis
○ Stylohyoid
○ Stapedius

Third Arch
○ Stylopharyngeus

Fourth Arch
○ Levator Veli Palatini
○ Palatoglossus
○ Palatopharyngeus
○ Muscularis Uvulae
○ Superior Constrictor
○ Middle Constrictor
○ Inferior Constrictor
○ Cricothyroides

Occipital Somite 1 (with some contribution from 2)
○ Posterior Cricoarytenoid
○ Lateral Cricoarytenoid
○ Oblique Arytenoid
○ Transverse Arytenoid
○ Thyroarytenoid
○ Vocalis
○ Aryepiglotticus
○ Thyroepiglotticus

Lateral Head Mesoderm
○ Sternocephalicus
○ Trapezius
OBJECTIVES

Skull Quiz
Rotation 1: Ventricles/Meninges
Rotation 2: Ligaments
Rotation 3: Skull
Rotation 4: Skull

PREPARATION

Advanced Anatomy Lecture Manual
Pages: 75-140

Pages: 1-10, 13-16, 94, 96-98, 108, 109, 143-149, 151, 155, 156

Pages: 4, 6, 8-13, 15-17, 19-21, 22, 23, 37, 38, 49, 63, 65, 99, 103, 104, 107, 108, 150-156, 252

Pages: 4-23, 35, 37, 38, 44, 62, 64, 100-105, 107, 109, 110, 116, 145-147, 153-159

Thieme Head & Neuroanatomy
Pages: 2-32, 186-188, 192-194
## Structures to Identify

### Skull

- **Sutures**
  - Coronal
  - Sagittal
  - Lambdoid
  - Squamous

- **Ethmoid bone**
  - Lamina Cribrosa
  - Foramina Cribrosa
  - Anterior Ethmoid Foramen or Notch
  - Posterior Ethmoid Foramen or Notch
  - Perpendicular Lamina
  - Crista Galli
  - Superior Nasal Concha
  - Middle Nasal Concha

- **Frontal bone**
  - Anterior Ethmoid Foramen or Notch
  - Posterior Ethmoid Foramen or Notch
  - Ethmoidal Notch
  - Foramen Caecum
  - Frontal Foramen or Notch
  - Supraorbital Foramen or Notch
  - Fossa for Lacrimal Gland

- **Hyoid bone**
  - Body
  - Greater Cornu
  - Lesser Cornu

- **Mandible**
  - Condyloid Process
  - Coronoid Process
  - Ramus
  - Angle
  - Mylohyoid Line
  - Digastric Fossa
  - Mandibular Foramen
  - Mandibular Canal
  - Mental Foramen

- **Maxilla**
  - Infraorbital Foramen
  - Infraorbital Canal
  - Alveolar Process
  - Incisive Fossa
  - Incisive Canal
  - Incisive Foramina

- **Maxilla (cont.)**
  - Greater Palatine Sulcus
  - Palatine Process
  - Maxillary Sinus

- **Nasal bones** - paired
  - Inferior Nasal Conchae bones - paired
  - Lacrimal bones - paired

- **Vomer**
  - Ala of Vomer

- **Occipital**
  - Clivus
  - Superior Nuchal Line
  - Inferior Nuchal Line
  - External Occipital Protuberance
  - Occipital Condyle
  - Pharyngeal Tubercle
  - Foramen Magnum
  - Jugular Notch
  - Hypoglossal Canal
  - Condylar Canal

- **Parietal bones** - paired
  - Foveola Granulares
  - Superior Temporal Line
  - Parietal Foramen

- **Sphenoid bone**
  - Clivus
  - Greater Wing
  - Spine of Sphenoid
  - Lesser Wing
  - Sella Turcica
  - Anterior Clinoid Process
  - Optic Canal
  - Superior Orbital Fissure
  - Inferior Orbital Fissure
  - Foramen Rotundum
  - Foramen Venosum
  - Foramen Ovale
  - Foramen Petrosum
  - Foramen Spinosum
  - Pterygoid Processes
  - Lateral Pterygoid Plate
  - Medial Pterygoid Plate
  - Hamulus
  - Pterygoid Canal
Palatine bones - paired
  ○ Horizontal Plate
  ○ Greater Palatine Sulcus
  ○ Lesser Palatine Foramina
  ○ Lesser Palatine Canals
  ○ Perpendicular Plate
  ○ Sphenopalatine Incisure
  ○ Pyramidal Process

Temporal bones - paired
  ○ Zygomatic Process
  ○ Mastoid Process
  ○ Mastoid Notch
  ○ Styloid Process
  ○ Mandibular Fossa
  ○ Petrotympanic Fissure
  ○ Tympanomastoid Fissure
  ○ External Acoustic Meatus
  ○ Carotid Canal
  ○ Tympanic Canaliculus
  ○ Jugular Fossa
  ○ Mastoid Canaliculus
  ○ Stylohyoid Foramen
  ○ Mastoid Foramen
  ○ Trigeminal Impression
  ○ Internal Acoustic Meatus
  ○ Hiatus for Greater Petrosal Nerve
  ○ Hiatus for Lesser Petrosal Nerve
  ○ Pharyngotympanic Tube
  ○ Canal for Tensor Tympani

Zygomatic bones - paired
  ○ Zygomaticofacial Foramen
  ○ Zygomatico-orbital Foramen
  ○ Zygomaticotemporal Foramen

Additional Skull Features (formed by adjacent bones)
  ○ Foramen Lacerum
  ○ Greater Palatine Foramen
  ○ Sphenopalatine Foramen
  ○ Palatovaginal Canal
  ○ Vomerovaginal Canal
  ○ Pterygopalatine Fossa
  ○ Pterygomaxillary Fissure
  ○ Pharyngeal canals

Ligaments
Ligaments of the Vertebral Column
  ○ Post-atlantoaxial Vertebral Ligaments
    ○ Anterior Longitudinal Ligament
    ○ Posterior Longitudinal Ligament
    ○ Ligamentum Flavum
    ○ Interspinous Ligament
    ○ Supraspinous Ligament
    ○ Nuchal Ligament

Craniovertebral Ligaments
  ○ Anterior Atlanto-occipital Membrane
  ○ Posterior Atlanto-occipital Membrane
  ○ Tectorial Membrane
  ○ Apical Ligament
  ○ Cruciform Ligament:
    ○ Transverse Ligament of Atlas
    ○ Superior and Inferior Longitudinal Bands

Additional Anatomy
  ○ Nucleus Pulposus
  ○ Annulus Fibrosus

Cerebrospinal System
Meninges and associated structures
  ○ Periosteal Dura
  ○ Meningeal Dura
  ○ Falx Cerebri
  ○ Tentorium Cerebelli
  ○ Falx Cerebelli
  ○ Subdural Space
  ○ Arachnoid Mater
  ○ Arachnoid Trabeculae
  ○ Subarachnoid Space
  ○ Denticulate Ligament
  ○ Pia Mater
  ○ Filum Terminale

Ventricles and associated structures
  ○ Lateral Ventricle
  ○ Septum Pellucidum
  ○ Interventricular Foramen (of Monroe)
  ○ Third Ventricle
  ○ Ventricular Aqueduct (of Sylvius)
  ○ Fourth Ventricle
  ○ Median Aperture (Foramen of Magendie)
  ○ Lateral Apertures (Foramina of Luschka)
  ○ Choroid Plexus
  ○ Arachnoid Villi
LABORATORY THREE

OBJECTIVES

Rotation 1: Spinal/Autonomic Nerve Anatomy
Rotation 2: Brain
Rotation 3: Problem Set
Rotation 4: Problem Set

PREPARATION

Advanced Anatomy Lecture Manual
Pages: 141-184


**Structures to Identify**

**Nervous System**

Spinal Nerve Anatomy
- Ventral and Dorsal Rootlets
- Ventral and Dorsal Roots
- Dorsal Root Ganglion
- Spinal Nerve Trunk
- Ventral Rami
- Dorsal Rami
- Cauda Equina

Branches of the Ventral Ramus
- Gray Communicating Ramus
- White Communicating Ramus
- Main Branch
- Lateral Cutaneous Branch
  - Anterior Branch
  - Posterior Branch
- Anterior Cutaneous Branch
  - Medial Branch
  - Lateral Branch
- Communicating Branch
- Collateral Branch
- Parasympathetic pelvic splanchnic nerve

Branches of the Dorsal Ramus
- Medial Branch
- Lateral Branch

Specific Named Branches of Dorsal Rami
- Suboccipital Nerve
- Greater Occipital Nerve
- Least Occipital Nerve
- Superior Clunial Nerves
- Middle Clunial Nerves

Autonomic Nerves
- Superior Cervical Ganglion
- Internal Carotid Nerve
- External Carotid Nerve
- Carotid Branch
- Middle Cervical Ganglion
- Ansa Subclavia
- Inferior Cervical Ganglion
- Vertebral Nerve
- Carotid Branch
- Cervicothoracic (Stellate) Ganglion
- Thoracic Ganglia
- Greater Thoracic Splanchnic Nerve
- Lesser Thoracic Splanchnic Nerve
- Least Thoracic Splanchnic Nerve
- Lumbar Splanchnic Nerves
- Sacral (Sympathetic) Splanchnic Nerves
- Pelvic (Parasympathetic) Splanchnic Nerves

Prevertebral or Collateral Ganglia
- Celiac Ganglia
- Superior Mesenteric Ganglia
- Aorticorenal Ganglia
- Inferior Mesenteric Ganglia

Brain

Telencephalon
- Limbic System
  - Hippocampus
  - Fornix
    - Mammillary Bodies
  - Corpus Callosum
  - Cerebral Cortex
  - Frontal Lobe
    - Precentral Gyrus
  - Central Lobe
  - Parietal Sulcus
  - Parieto-occipital Sulcus
  - Occipital Lobe
    - Calcarine Sulcus
  - Lateral Sulcus
  - Temporal Lobe
  - Insula

Diencephalon
- Thalamus
  - Lateral Geniculate Nucleus
  - Medial Geniculate Nucleus
- Optic Chiasma
- Optic Tract
- Hypothalamus
- Infundibular Stalk
- Posterior Pituitary Gland (Neurohypophysis)
- Pineal Body

Mesencephalon
- Cerebral Peduncles
- Corpora Quadrigemina
  - Inferior Colliculi
  - Superior Colliculi
Metencephalon
  ○ Pons
  ○ Cerebellar Peduncles
  ○ Cerebellum

Myelencephalon
  ○ Medulla Oblongata
  ○ Olive
  ○ Pyramid
  ○ Pyramidal Decussation

Spinal Cord
  ○ Anterior Median Sulcus
  ○ Posterior Median Sulcus
  ○ Posterior Lateral Sulcus
  ○ Anterior Lateral Sulcus
  ○ Posterior Funiculus
  ○ Lateral Funiculus
  ○ Anterior Funiculus
  ○ Dorsal Horn or Column
  ○ Ventral Horn or Column
  ○ Lateral Horn or Column
  ○ Conus Medullaris
LABORATORY
FOUR

OBJECTIVES

Rotation 1: Skull Practicum
Rotation 2: Cervical Plexus
Rotation 3: Problem Set
Rotation 4: Problem Set

PREPARATION

Advanced Anatomy Lecture Manual
Pages: 159-176
Pages: 31, 32, 129-131, 177, 178, 240
Pages: 30-32, 128, 129, 171, 172, 234
Thieme Neck and Internal Organs
Pages: 44-49
Structures to Identify

Cervical Plexus
Lateral Cutaneous Branches
  ○ Lesser Occipital Nerve
  ○ Great Auricular Nerve
  ○ Transverse Cervical Nerve
  ○ Supraclavicular Nerve

Anterior Muscular Branches
  ○ Phrenic Nerve
  ○ Communicating from Hypoglossal Nerve
  ○ Geniohyoid Nerve
  ○ Thyrohyoid Nerve
  ○ Ansä Cervicalis - Superior Root
  ○ Superior Omohyoid Nerve
  ○ Ansä Cervicalis - Inferior Root
  ○ Sternothyroid Nerve
  ○ Sternohyoid Nerve
  ○ Inferior Omohyoid Nerve
  ○ Phrenic Nerve

Communicating Branches
  ○ Communicating Nerves to Accessory Nerve
  ○ Nerve to Sternocecidostoid
  ○ Nerve to Trapezius
  ○ Sympathetic Gray Communicating Rami
  ○ Communication with Vagus Nerve
LABORATORY
FIVE

OBJECTIVES
Rotation 1: Review
Rotation 2: Brachial Plexus
Rotation 3: Problem Set
Rotation 4: Problem Set

PREPARATION
Advanced Anatomy Lecture Manual
Pages: 177-195
STRUCTURES TO IDENTIFY

Brachial Plexus
- Roots
- Trunks
  - Superior Trunk
  - Middle Trunk
  - Inferior Trunk
- Divisions
  - Anterior Divisions
  - Posterior Divisions
- Cords
  - Lateral Cord
  - Medial Cord
  - Posterior Cord

Pre-Division Nerves
- Accessory Phrenic Nerve
- Long Thoracic Nerve
- Suprascapular Nerve
- Dorsal Scapular Nerve
- Nerve to Subclavius

Anterior Division Nerves
- Lateral Pectoral Nerve
- Medial Pectoral Nerve
- Medial Brachial Cutaneous Nerve
  - Intercostobrachial Nerve
- Medial Antebrachial Cutaneous Nerve
- Ulnar Nerve
  - Dorsal Branch
  - Palmer Branch
  - Common Palmar Digital Nerve
  - Proper Palmer Digital Nerve
  - Anastomotic Branch to Median Nerve
- Median Nerve
  - Medial Root of Median Nerve
  - Lateral Root of Median Nerve
  - Anterior Interosseous Nerve
  - Palmer Branch
  - Superficial Branch
    - Common Palmar Digital Branch
    - Proper Palmer Digital Branch
    - Deep Branch
- Musculocutaneous Nerve
  - Lateral Antebrachial Cutaneous Nerve

Posterior Division Nerves
- Upper Subscapular Nerve
- Thoracodorsal Nerve
- Lower Subscapular Nerve
- Axillary Nerve
  - Superior Lateral Brachial Cutaneous Nerve
- Radial Nerve
  - Posterior Brachial Cutaneous Nerve
  - Inferior Lateral Brachial Cutaneous Nerve
  - Posterior antebrachial Cutaneous Nerve
  - Deep Branch
    - Posterior Interosseous Nerve
    - Superficial Branch
    - Dorsal Digital Branches
LABORATORY SIX

OBJECTIVES

Rotation 1: Lumbosacral Plexus
Rotation 2: Lumbosacral Plexus
Rotation 3: Problem Set
Rotation 4: Problem Set

PREPARATION

Advanced Anatomy Lecture Manual
Pages: 201-244


Pages: 34, 157-159, 173, 243-249, 251, 253-255, 326, 367, 389-393, 484-491, 504-510, 517-531
Structures to Identify

**Lumbar Plexus**

Body Wall Branches
- Subcostal Nerve
- Liiohypogastric Nerve
- Ilio-inguinal Nerve
- Genitofemoral Nerve
  - Genital Branch
  - Femoral Branch

Lower Limb Branches
- Lateral Femoral Cutaneous Nerve
- Femoral Nerve
  - Muscular Branches
  - Anterior Cutaneous Branches
- Saphenous Nerve
- Infrapatellar Branches
  - Medial Crural Cutaneous Nerve
- Obturator Nerve
  - Anterior Branch
  - Cutaneous Branch
  - Posterior Branch

**Spermatic Cord/Inguinal Canal**
- Superficial/Dartos Fascia
- External Spermatic Fascia
- Cremasteric Fascia
- Internal Spermatic Fascia
- Tunica Vaginalis - Parietal Layer
- Tunica Vaginalis - Visceral Layer
- Tunica Albuginea

**Sacral Plexus**
- Lumbosacral Trunk
- Upper Bands
- Lower Bands
  - Superior Gluteal Nerve
  - Inferior Gluteal Nerve
  - Nerve to Superior Gemellus/Obturator Internus
  - Nerve to Inferior Gemellus/Quadratus Femoris
  - Pudendal Nerve
    - Inferior Anal Nerves
    - Perineal Nerves
  - Posterior Femoral Cutaneous Nerve
    - Inferior Clunial Nerves
  - Perforating Cutaneous Nerve
  - Nerve to Piriformis
  - Coccygeal Nerve
  - Sciatic Nerve
    - Tibial Nerve
      - Medial Sural Cutaneous Nerve
      - Sural Nerve
      - Medial Calcaneal Nerve
      - Medial Plantar Nerve
      - Lateral Plantar Nerve
    - Common Peroneal (Fibular) Nerve
      - Lateral Sural Cutaneous Nerve
      - Sural Communicating Branch
      - Superficial Fibular Nerve
        - Medial Dorsal Cutaneous Nerve
        - Intermediate Dorsal Cutaneous Nerve
      - Deep Fibular Nerve
        - Dorsal Digital Nerves

**Body Wall Fascial Pattern**
- Epidermis
- Dermis
- Subcutaneous layer/Hypodermis
- External Investing Fascia/Deep Fascia
- Muscle Wall
- Internal Investing Fascia
- Subserous Fascia/Extrareral fascia
- Parietal Membrane

**Rectus Sheath Anatomy**
- Anterior Lamina of Rectus Sheath
- Posterior Lamina of Rectus Sheath
- Semilunar Line
- Linea Alba
- Arcuate Line
LABORATORY
SEVEN

OBJECTIVES

Rotation 1: Arteries of the Head and Neck
Rotation 2: Extra-cranial Veins and Dural Sinuses
Rotation 3: Problem Set
Rotation 4: Problem Set

PREPARATION

Advanced Anatomy Lecture Manual
Pages: 245-261

Pages: 21, 23, 31, 34, 36, 40, 69, 70, 85, 100-106, 136-145, 171-173

Pages: 3, 22, 30, 33, 35, 39, 69, 70, 85, 100-105, 135-143, 164-167

Thieme Head & Neuroanatomy
Pages: 54-65, 246-258, 286
Structures to Identify

Arteries of the Head and Neck
- External Carotid Artery
  - Superior Thyroid Artery
  - Lingual Artery
  - Ascending Pharyngeal Artery
  - Facial Artery
  - Occipital Artery
  - Posterior Auricular Artery
  - Superficial Temporal Artery
    - Transverse Facial Artery
  - Maxillary Artery
    - Middle Meningeal Artery
    - Inferior Alveolar Artery
- Internal Carotid Artery
  - Ophthalmic Artery
  - Anterior Cerebral Artery
  - Anterior Communicating Artery
  - Anterior Choroid Artery
  - Middle Cerebral Artery
  - Posterior Communicating Artery
- Vertebral Artery
  - Anterior Spinal Artery
  - Posterior Inferior Cerebellar Artery
- Basilar Artery
  - Anterior Inferior Cerebellar Artery
  - Superior Cerebellar Artery
  - Posterior Cerebral Artery

Extra-cranial Veins
- External Jugular Vein
  - Anterior Jugular Vein
  - Posterior External Jugular Vein
  - Posterior Auricular Vein
  - Posterior Retromandibular Vein
  - Maxillary Vein
  - Superficial Temporal Vein
- Internal Jugular Vein
  - Lingual Vein
  - Pharyngeal Vein
  - Superior Thyroid Vein
  - Facial Vein
  - Anterior Retromandibular Vein
  - Communicating Facial Vein

Dural Venous Sinuses
- Superior Sagittal Sinus
- Inferior Sagittal Sinus
- Straight Sinus
- Transverse Sinus
- Sigmoid Sinus
- Superior Petrosal Sinus
- Inferior Petrosal Sinus
- Basilar Sinus
- Cavernous Sinus
- Sphenoparietal Sinus
- Occipital Sinus

Spinal Cord Arteries
- Spinal (Radicular) Artery
- Anterior Radicular Artery
- Posterior Radicular Artery
- Anterior Spinal Artery
- Posterior Spinal Artery
- Sulcal/Central Artery
- Pial/Superficial Artery

Vertebral Veins
- Internal Vertebral Venous Plexus
- External Vertebral Venous Plexus
- Basivertebral vein
- Intervertebral Vein
LabORATORY EIGHT

OBJECTIVES

Rotation 1: Midterm Practicum
Rotation 2: Cranial Nerves I-IV, VI, VIII, XII
Rotation 3: Problem Set
Rotation 4: Problem Set

PREPARATION

Advanced Anatomy Lecture Manual
   Pages: 265-292

   Pages: 32, 42, 43, 45, 48, 70, 71, 83, 86, 92, 95-97, 104, 114, 116-121, 128, 131, 132

   Pages: 31, 41, 42, 44, 48, 70, 71, 83, 86, 92, 95-97, 103, 113, 115-120, 127, 130, 131

Thieme Head & Neuroanatomy
   Pages: 66, 67, 70-73, 82, 88, 90, 109, 137, 144, 226, 227
Structures to Identify

Ventral (Somitic) Cranial Nerves

Nerves to Preotic Somites
- Oculomotor Nerve (III)
  - Superior Division
    - Nerve to superior rectus muscle
    - Nerve to levator palpebrae superioris m.
  - Inferior Division
    - Nerve to medial rectus muscle
    - Nerve to inferior rectus muscle
    - Nerve to inferior oblique muscle
- Ciliary ganglion
- Short Ciliary Nerve
- Trochlear Nerve (IV)
- Abducens Nerve (VI)

Nerves to Occipital Somites
- Hypoglossal Nerve (XII)

Special Sensory Nerves
- Olfactory Nerve (I)
- Optic Nerve (II)
  - Optic Chiasma
  - Optic Tract
  - Lateral Geniculate Nucleus
  - Optic Radiations
- Vestibulocochlear Nerve (VIII)

Mnemonics:

- Oh, Olfactory I
- Oh, Optic II
- Oh, Oculomotor III
- To Trochlear IV
- Touch Trigeminal V
- A Abducens VI
- Few Facial VII
- Very Vestibulocochlear VIII
- Green Glossopharyngeal IX
- Vegetables Vagus X
- A Accessory XI
- H Hypoglossal XII

Some I
Say II
Money III
Matters IV
But V
My VI
Brother VII
Says VIII
Big IX
Boobs X
Matter XI
Most XII

(Key: S=sensory; M=motor; B=both)
LABORATORY NINE

OBJECTIVES

Rotation 1: Cranial Nerve V
Rotation 2: Cranial Nerve VII/Review
Rotation 3: Problem Set
Rotation 4: Problem Set

PREPARATION

Advanced Anatomy Lecture Manual
Pages: 293-319


Pages: 2, 24, 30, 35, 39, 41-47, 60-62, 71, 86, 92, 94, 97, 103, 113, 115-117, 121, 122, 130-134

Thieme Head & Neuroanatomy
Pages: 66, 67, 92-98, 101, 226, 227
Structures to Identify

Dorsal (Branchial) Cranial Nerves
- Trigeminal Nerve (V)
- Trigeminal (Semilunar) Ganglion
  - Ophthalmic Nerve (V1)
    - Lacrimal Nerve
      - Communication with Zygomatic Nerve
    - Frontal Nerve
      - Supratrochlear Nerve
      - Supraorbital Nerve
  - Nasociliary Nerve
    - Long Ciliary Nerve
    - Posterior Ethmoidal Nerve
    - Anterior Ethmoidal Nerve
      - Internal Nasal Nerve
        - Medial Internal Nasal Branches
        - Lateral Internal Nasal Branches
      - External Nasal Nerve
      - Infratrochlear Nerve
  - Maxillary Nerve (V2)
    - Branches to pterygopalatine ganglion
      - Posterior Superior Lateral Nasal branches
    - Posterior Inferior Lateral Nasal branches
    - Nasopalatine Nerve
    - Pharyngeal Nerve
    - Greater Palatine Nerve
    - Lesser Palatine Nerve
  - Zygomatic Nerve
    - Zygomaticofacial Nerve
    - Zygomaticotemporal Nerve
  - Superior Alveolar Nerves
    - Posterior Superior Alveolar Nerves
    - Middle Superior Alveolar Nerves
    - Anterior Superior Alveolar Nerves
  - Infraorbital Nerve
    - Inferior Palpebral Branches
    - Internal Nasal Branches
    - External Nasal Branches
    - Superior Labial Branches
- Mandibular Nerve (V3)
  - Meningeal Nerve (nervous spinosus)
  - Nerve to Medial Pterygoid
  - Nerve to Tensor Veli Palatini
  - Nerve to Tensor Tympani
  - Masseteric Nerve
  - Deep Temporal Nerves
  - Nerve to Lateral Pterygoid
  - Buccal Nerve
  - Auriculotemporal Nerve
  - Lingual Nerve
    - Branches to Submandibular Ganglion
    - Submandibular Ganglion
  - Inferior Alveolar Nerve
    - Nerve to Mylohyoid
    - Nerve to Anterior Digastricus
    - Mental Nerve
- Facial Nerve (VII)
  - Geniculate Ganglion
Intratemporal Branches of Facial Nerve
  - Greater Petrosal Nerve
    - Nerve of Pterygoid Canal (Vidian Nerve)
  - Nerve to Stapedius
  - Chorda Tympani Nerve
  - Communication with Auricular of Vagus
Extratemporal Branches
Pre-Parotid Branches
  - Posterior Auricular
  - Nerve to Posterior Digastricus
  - Nerve to Stylohyoid
Intraparotid Branches
  - Temporal Nerve
  - Zygomatic Nerve
  - Buccal Nerve
  - Marginal Mandibular Nerve
  - Cervical Nerve
LABORATORY

TEN

OBJECTIVES

Rotation 1: Cranial Nerves IX, X, and XI
Rotation 2: Review
Rotation 3: Problem Set
Rotation 4: Problem Set

PREPARATION

Advanced Anatomy Lecture Manual
Pages: 321-344

Pages: 32-35, 47, 60, 62, 64, 67, 69, 70, 71, 74-76, 80, 114, 116-118, 125-131, 135

Pages: 31-33, 47, 60, 62, 64, 67, 70, 71, 74-76, 80, 112, 115-117, 124-130, 134

Thieme Head & Neuroanatomy
Pages: 66-69, 84-91, 106, 107, 226-228
Structures to Identify

Dorsal (Branchial) Cranial Nerves
○ Glossopharyngeal Nerve (IX)
  ○ Superior Ganglion
  ○ Inferior Ganglion
  ○ Tympanic Nerve
    ○ Tympanic Plexus
    ○ Lesser Petrosal Nerve
      ○ Otic Ganglion
  ○ Communicating Branch with Auricular of Vagus
  ○ Pharyngeal Branches
  ○ Nerve to Stylopharyngeus
  ○ Carotid branches
  ○ Tonsillar Branches
  ○ Lingual branches

○ Vagus Nerve (X)
  ○ Cranial Accessory Nerve
  ○ Superior Ganglion
    ○ Auricular Nerve
  ○ Inferior Ganglion
  ○ Pharyngeal Branch
  ○ Superior Laryngeal Nerve
    ○ External Branch
    ○ Internal Branch
  ○ Cervical Cardiac Branches
  ○ Recurrent Laryngeal Nerve
  ○ Thoracic Cardiac Branches
  ○ Pulmonary Plexus
  ○ Esophageal Plexus
  ○ Anterior Vagal Trunk
  ○ Posterior Vagal Trunk

○ Accessory Nerve (XI)
  ○ Spinal Accessory Nerve
  ○ Muscular Branches
  ○ Communication to Cervical Plexus