# Applied Human Anatomy

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# About this Book



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Virginia Tech Carilion School of Medicine
in association with Virginia Tech Publishing
Blacksburg, VA

A free version of this book can be downloaded from:
https://doi.org/10.21061/applied-human-anatomy

Cover photos by Ryan Anderson, Virginia Tech Carilion School of Medicine

We wish to thank Ryan Anderson for the book cover photos, and VTCSOM Class of 2026 students Sydney Dinn, Maedot Haymete, Lucy Honeycutt, Katherine Lee, Thisha Thiagarajan and Jessica Urbanczyk for permission to use their photos for the book cover.



First published in 2022 by the Virginia Tech Carilion School of Medicine in association with Virginia Tech Publishing

Virginia Tech Carilion School of Medicine
2 Riverside Circle
Roanoke, VA 24016 USA

Virginia Tech Publishing
University Libraries at Virginia Tech
560 Drillfield Drive
Blacksburg, VA 24061 USA




**Cataloging-in-Publication Data**
Names: Nolan, Michael F., author | McNamara, John P., author.
Title: Applied Human Anatomy / Michael F. Nolan and John P. McNamara.
Description: Roanoke, VA : Virginia Tech Carilion School of Medicine in association with Virginia Tech Publishing, 2022. | Summary: “These practical exercises help students acquire a fundamental understanding of anatomical structure and relationships as encountered in living persons.” – Preface.
Identifiers: ISBN: 978-1-957213-41-5 (PDF) | ISBN: 978-1-957213-95-8 (pbk) | DOI: https://doi.org/10.21061/applied-human-anatomy
Subjects: HUMAN ANATOMY / Laboratory manuals. | HUMAN ANATOMY / Problems and Exercises.

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# Preface

The ability to relieve discomfort and effectively treat injury, disease and disability requires a clear understanding of the structural and functional bases of a variety of abnormal conditions. Such knowledge of abnormal structure and function is most effectively acquired and easily accessed when it is built upon a firm understanding of normal structure and function. Thus, one of the first goals of students of the health care professions is to acquire an adequate working knowledge of normal structure and function, including variations and ranges in structure and function that are commonly understood to represent the normal condition.

The structure of the human body is usually considered in courses in gross anatomy. These courses typically consist of lectures by the faculty, readings in assigned textbooks and the study of photographs and illustrations in human anatomy atlases. Depending on the resources of the educational program, students may also have access to skeletal material, anatomical models, video tape presentations of cadaver prosections and other specialized learning aids. Other computer-aided-instruction programs have been developed that combine a number of self-directed learning and assessment strategies.

Some gross anatomy courses offer the opportunity to dissect and study human cadaveric material, thereby providing students with a somewhat more realistic, three-dimensional perspective of individual tissues and organs and their anatomical relationship to one another. The use of cadavers and cadaveric material is considered by many to be essential for students requiring a thorough and complete knowledge of human structure.

However, as student's progress through the curriculum and move into the more clinical or practice oriented phases, many discover that the anatomical knowledge they actually need is somewhat different from the kind they possess. What many encounter is difficulty in applying in the clinical setting, the facts and principles previously learned in the classroom and dissection laboratory. This difficulty often becomes evident in clinical skills courses in which students work with and learn from living persons, many of whom are patients. Student difficulty in making this transition points to a need which can be effectively addressed within the context of most human anatomy courses. Namely, the need to acquire a fundamental understanding of anatomical structure and relationships as encountered in living persons. The practical exercises in this manual are intended to help meet that need.

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# Introduction

The exercises in this manual are intended to bridge the gap between non-living and living anatomy by helping students acquire a practical understanding of certain aspects of human gross anatomy as can be appreciated in living human subjects. This manual is intended as a companion text comprised of self-assessment questions and application exercises to be used in conjunction with traditional materials in courses in human gross anatomy whether or not such courses also provide opportunities to dissect and study cadaveric material. Individual exercises have been developed with an eye toward preparing students for subsequent course work that may be dependent on a firm understanding of human gross anatomy. The fill-in-the-blank questions are intended for use as a self-assessment tool and to provide feedback with regard to a student's progress in learning the material.

An important goal in preparing this manual was to better integrate material that is more often than not treated separately in contemporary health care curricula. It is hoped that through this integration students will develop a deeper and more lasting knowledge and understanding of human anatomy as they are likely to need it in the evaluation and management of patients.

# How to Use the Manual

The exercises described in this manual are group activities, intended and designed for small numbers of students working together. Each work group should ideally consist of four to six students, preferably mixed with regard to body size, shape, age, gender and race. The intent of building diversity within the work group is to permit students to gain familiarity with as wide a variety of human anatomy as class enrollment will permit. Students should dress in comfortable clothing that does not prohibit visualization or palpation of important anatomical landmarks and structures.

Each student in the work group should take a turn as the subject for each exercise performed by each of the other members of the group. Clearly, the greatest benefit is achieved when each student performs each exercise on all other members of the group. In this way variations in anatomical structure that exist within the group can be identified, compared and discussed in relation to a student's developing concept of normal human anatomy. The short, written questions that accompany many of the exercises can be answered as one progresses through the manual as a way of self-assessment and as a prompt for thought and discussion about the anatomy being studied. Alternatively, they can be answered before performing the exercises as a way of preparing for subsequent group work. Where there is one line following a question, only one answer is sought. Where more than one line is provided, an equivalent number of answers is sought.

Many of the exercises described in this manual involve palpation and learning through the sense of touch. This approach to learning human anatomy, though overlooked in most traditional anatomy courses, is emphasized here in recognition of the fact that physicians and other health care workers regularly use their hands as well as their eyes and ears to obtain information about their patients. It is therefore important for students to become familiar with human structure as it appears to the hands and fingertips. Not coincidentally, many of the exercises and tasks outlined in this manual are similar or identical to those actually used in the evaluation and treatment of patients. Please view these learning activities as serious and necessary parts of your educational and professional development, and treat your work group partners with the respect and sensitivity you would wish them to extend to you.

# 1 Back and Spine

**Objectives**

1. Describe and identify by palpation in a living subject the major curvatures of the vertebral column.

2. Describe and identify by palpation in a living subject the major bony landmarks of the back.

3. Identify and describe joints and ligaments of the vertebral column.

4. Describe and demonstrate using a living subject the movements both permitted and restricted at each of the four regions of the vertebral column.

5. Define abnormal curvatures of the vertebral column and describe common compensatory mechanisms that result from the abnormal curves.

**Anatomy Review Questions**

The vertebral column is stabilized and intervertebral movement is limited (restricted) by ligaments that interconnect the vertebrae. Name the ligaments that course from:

1. vertebral body to vertebral body anteriorly

   _____

2. vertebral body to vertebral body posteriorly

   _____

3. lamina to lamina

_____

4. transverse process to transverse process

_____

5. spinous process to spinous process

_____

6. tip of the spinous process to tip of the spinous process

_____

7. Which vertebra presents the carotid tubercle?

_____

8. Which vertebra presents the dens?

_____

9. Is the dens positioned anterior or posterior to the vertebral canal?

_____

10. Which spinal nerve is located in the C7 – T1 intervertebral foramina?

_____

The muscles of the back can be conveniently divided into two groups; the superficially located erector spinae and the more deeply located transversospinal group.

11. What muscles comprise the erector spinae?

    a. _____

    b. _____

    c. _____

12. What muscles comprise the transversospinal group?

    a. _____

    b. _____

    c. _____

13. What are the most superficial back muscles in the region of the cervical spine?

    a. _____

    b. _____

14. The suboccipital muscles play a role in both stabilizing and moving the head on the spine. What are the major suboccipital muscles?

    a. _____

    b. _____

    c. _____

    d. _____

15. The greatest range of cervical motion in the transverse (axial) plane occurs between what two vertebrae?

    _____

16. What is the name of the central, fluid-like component of the intervertebral disc?

    _____

17. What is the name of the peripheral, fibrous component of the intervertebral disc?

_____

18. What structure is located in the transverse foramen?

_____

19. Where is Batson's plexus of veins located?

_____

20. What segmental nerve emerges from within the suboccipital triangle?

_____

21. What vascular structure passes through the posterior atlanto-occipital membrane?

_____

22. What three muscles form the triangle of auscultation?

a. _____

b. _____

c. _____

23. What three muscles form the lumbar (Petit's) triangle?

a. _____

b. _____

c. _____

## Application Exercises

*A. Inspection and Palpation*

With the subject standing comfortably and the back and shoulders exposed:

1. Inspect the midline of the back from the skull to the sacrum.

   a. Is the vertebral column straight or are there curvatures in either the frontal (coronal) or sagittal plane?

      _____

   b. Which segments of the vertebral column are concave posteriorly?

      1) _____

      2) _____

   c. An increase in the curvature of either of these parts of the vertebral column in the sagittal plane is referred to as

      _____

   d. Which segments of the vertebral column are convex posteriorly?

      1) _____

      2) _____

   e. An increase in the curvature of the thoracic spine in the sagittal plane is referred to as

      _____

   f. An increase in the curvature of the vertebral column in the coronal plane is referred to as

      _____

2. Palpate the external occipital protuberance and slide your fingers inferiorly in the midline until you feel a prominent bony prominence.

   a. What is the name of this bony prominence?

   _____

   b. What is the name of this part of the vertebra?

   _____

   c. Which vertebra is this palpable feature a part of?

   _____

   d. Were you able to feel the vertebral column in the region between the external occipital protuberance and palpable bony feature?

   _____

   If not, indicate why.

   _____

   e. What is the name of the structure you palpated as you slid your fingers inferiorly in the midline of the neck?

   _____

3. Palpate the posterior cervical muscles bilaterally and compare the size and contour of the muscles on each side of the neck.

   a. What is the superior attachment of this group of muscles?

   _____

4. Palpate the spinous process of C7 (vertebra prominens) and slide your fingers inferiorly in the midline until you feel the sacrum.

   a. Were you able to feel all the thoracic and lumbar spinous processes throughout the length of the vertebral column?

      _____

5. Palpate the thoracic and lumbar paraspinal muscles bilaterally and compare the size and contour of the muscles on each side.

   a. Are the two sides symmetrical?

      _____

      If not, describe the differences.

      _____

6. Palpate the iliac crests together.

   a. Are both at the same horizontal level with respect to the ground?

      _____

      If not, indicate which is higher (or lower)?

      _____

   b. Which vertebra would be crossed by a line drawn between the iliac tubercle? (transtubercular line)

      _____

7. While standing behind the subject, place your hands on the subject's shoulders (right hand on right shoulder and left hand on left shoulder).

   a. Are the shoulders level (at the same level relative to the floor)?

   _____

   If not, indicate which is higher (or lower).

   _____

8. With the subject standing comfortably, instruct the subject to bend forward at the waist in attempt to touch the floor.

   a. Is the subject able to touch the floor with both hands (or finger tips)?

   _____

   If not, how far from the floor are the tips of the fingers:

   right hand _____

   left hand _____

   b. Are the angles of the ribs level with the floor or is one side higher than the other?

   _____

   If one side is higher, which side is higher?

   _____

9. With the subject standing comfortably, instruct the subject to bend backward at the waist as far as possible. (NOTE: Stand behind the subject to prevent a fall.)

   a. Was the subject able to bend backward and without leaning to one side?

   _____

   b. Did the subject report any pain or discomfort with this movement?

   _____

10. With the subject standing comfortably, instruct the subject to bend laterally at the waist to the right as far as comfortable then to the left.

   a. Was the subject able to bend the same amount in both directions?

   _____

   If not, approximate (or measure) in degrees the amount of lateral bending achieved in each direction.

   To the right _____

   To the left _____

11. With the subject standing comfortably, instruct the subject to rotate the trunk, first to the right then to the left.

   a. Was the subject able to rotate equally in both directions?

   _____

If not, approximate (or measure in degrees) the amount of rotation achieved in each direction.

To the right _____

To the left _____

*B. Movement (Muscles and Joints)*

The vertebral column is stabilized and intervertebral movement is limited (restricted) by ligaments that interconnect the vertebrae. Name the ligaments that course from:

1. vertebral body to vertebral body anteriorly

_____

2. vertebral body to vertebral body posteriorly

_____

3. lamina to lamina

_____

4. transverse process to transverse process

_____

5. spinous process to spinous process

_____

6. tip of the spinous process to tip of the spinous process

_____

The muscles of the back can be conveniently divided into two groups; the superficially located erector spinae and the more deeply located transversospinal group.

7. What muscles comprise the erector spinae?

   a. _____

   b. _____

   c. _____

8. What muscles comprise the transversospinal group?

   a. _____

   b. _____

   c. _____

9. What are the most superficial back muscles in the region of the cervical spine?

   a. _____

   b. _____

10. The suboccipital muscles play a role in both stabilizing and moving the head on the spine. What are the major suboccipital muscles?

    a. _____

    b. _____

    c. _____

    d. _____

# 2 Shoulder Girdle and Upper Limb

**Objectives**

1. Describe and identify by palpation in a living subject the major soft tissue and bony landmarks of the upper limb.

2. List the action and innervation of the major muscle groups of the upper limb.

3. List the major muscles responsible for movements permitted at each joint of the upper limb.

4. Identify the major ligaments of the upper limb and describe the movements limited or restricted by each.

5. Describe and identify by palpation in a living subject the major arterial pulses in the upper limb.

6. Identify and outline on a living subject, the area of skin innervated by each of the pre-plexus roots of the brachial plexus.

7. Identify and outline on a living subject, the area of skin innervated by each of the post plexus peripheral nerves of the brachial plexus.

8. Describe the movements that would be affected as a result of lesions affecting the pre-plexus roots of the brachial plexus.

9. Describe the movements that would be affected as a result of lesions affecting post plexus peripheral nerves of the brachial plexus.

**Anatomy Review Questions**

1. What joint is located at the medial end of the clavicle?

   _____

2. What joint is located at the lateral end of the clavicle?

   _____

3. What two ligaments resist dislocation of the acromioclavicular joint?

   a. _____

   b. _____

4. What ligament of the shoulder region does NOT cross a movable joint?

   _____

5. What ligament helps to secure the head of the radius against the radial notch of the ulna?

   _____

6. Describe the fiber direction of the interosseous membrane of the forearm.

   _____

7. What tendon passes superficial to the flexor retinaculum (transverse carpal ligament)?

   _____

8. What anatomical landmark marks the point where the subclavian becomes the axillary artery?

   _____

9. What anatomical landmark marks the point where the axillary artery becomes the brachial artery?

_____

10. What landmarks are used to divide the axillary artery into three (3) parts?

_____

11. Name the major branches of the axillary artery:

first part _____

second part _____

_____

third part _____

_____

_____

12. What artery lies along the medial (vertebral) border of the scapula?

_____

13. What two arteries enter the hand by passing deep to the flexor retinaculum?

a. _____

b. _____

14. Name the bones that form the proximal row of carpal bones.

a. _____

b. _____

c. _____

d. _____

15. Name the bones that form the distal row of carpal bones.

    a. _____

    b. _____

    c. _____

    d. _____

16. What muscle forms the medial wall of the axilla?

    _____

17. What anatomical feature marks the lateral wall of the axilla?

    _____

18. Which spinal nerve roots contribute to the formation of the brachial plexus?

    _____ to _____

19. Which root(s) give rise to the:

    a. upper trunk _____

    b. middle trunk _____

    c. lower trunk _____

20. Which division of the brachial plexus gives rise to the posterior cord?

    _____

21. Which trunk of the brachial plexus gives rise to the suprascapular nerve?

    _____

22. Which cord gives rise to the nerve that innervates the latissimus dorsi muscle?

    _____

23. Which cord gives rise to the nerve that innervates the teres major muscle?

_____

24. Which cord gives rise to the nerve that innervates the subscapularis muscle?

_____

25. Which cord gives rise to the nerve that innervates the pectoralis minor muscle?

_____

26. What are the two terminal branches of the posterior cord?

a. _____

b. _____

27. What nerve passes through the quadrangular space?

_____

28. What nerve lies in the spiral groove?

_____

29. What nerve lies posterior to the medial epicondyle?

_____

30. What nerve passes deep to the flexor retinaculum?

_____

31. What nerve passes through Guyon's canal?

_____

32. What is the average carrying angle in:

Women _____

Men _____

33. The median nerve crosses the cubital fossa and enters the forearm by passing between the two heads of what muscle?

_____

34. The ulnar nerve passes posterior to the medial epicondyle and enters the forearm by passing between the two heads of what muscle?

_____

35. The radial nerve passes into the cubital fossa anterior to the lateral epicondyle, passing between what two muscles?

a. _____

b. _____

36. Axillary lymph nodes are distributed in several different “groups.” Name five of these clusters of axillary lymph nodes.

a. _____

b. _____

c. _____

d. _____

e. _____

37. What tendons form the borders of the “anatomical snuff box”?

a. medial border _____

b. lateral border _____

38. The pulse of what artery can be palpated in the “anatomical snuff box”?

_____

**Application Exercises**

*A. Inspection and Palpate*

With the subject seated comfortably and the back, shoulders and upper limbs exposed:

1. Inspect and palpate the superior border of the trapezius.

    a. Are the right and left sides visually symmetrical with regard to muscle contour and bulk?

    _____

    If not, describe the differences.

    _____

    b. Are the right and left sides symmetrical to palpation?

    _____

    If not, describe the differences.

    _____

2. Inspect and palpate the clavicle from the sternoclavicular joint to the acromioclavicular joint.

    a. What kind of movement is permitted at the sternoclavicular joint?

    _____

b. What kind of movement is permitted at the acromioclavicular joint?

_____

3. Inspect the deltoid muscle and palpate the anterior and posterior margins of this muscle.

a. Are the right and left sides visually symmetrical with regard to muscle contour and bulk?

_____

If not, describe the differences.

_____

b. Are the right and left sides symmetrical to palpation?

_____

If not, describe the differences.

_____

4. Palpate the spine of the scapula from its medial to lateral extent.

a. What is the name of the bony prominence at the lateral end of the spine of the scapula?

_____

b. In a relaxed individual with both arms hanging comfortably at the sides, which thoracic vertebral body would be crossed by a line interconnecting the medial edge of the spines of the two scapulae?

_____

c. What muscle originates in the space superior to the spine of the scapula?

_____

d. What muscle originates in the space inferior to the spine of the scapula?

_____

5. Palpate the vertebral border, lateral border and inferior angle of the scapula.

a. What is the average distance between the spinous processes of the vertebral column and the vertebral border of the scapula?

_____

b. What rib is covered by the superior angle of the scapula?

_____

c. What rib is covered by the inferior angle of the scapula?

_____

6. Palpate the anterior and posterior axillary folds.

a. What muscle forms the anterior axillary fold?

_____

1) What two peripheral nerves provide motor innervation to this muscle?

_____

_____

b. What two muscles form the posterior axillary fold?

_____

_____

1) What two peripheral nerves provide motor innervation to these muscles?

_____

_____

7. Inspect and palpate the muscles of the anterior compartment of the arm.

a. What two muscles form the bulk of the anterior compartment of the arm?

_____

_____

1) What peripheral nerve provides motor innervation to these muscles?

_____

b. Are the right and left sides visually symmetrical with regard to muscle contour and bulk?

_____

If not, describe the differences.

_____

8. Inspect and palpate the muscles of the posterior compartment of the arm.

   a. What muscle forms the bulk of the posterior compartment of the arm?

      _____

      1) What peripheral nerve provides motor innervation to this muscle?

         _____

   b. Are the right and left sides visually symmetrical with regard to muscle contour and bulk?

      _____

      If not, describe the differences.

      _____

9. Inspect and palpate the olecranon process of the ulna.

   a. What muscle inserts on the olecranon process?

      _____

   b. What peripheral nerve lies immediately medial to the olecranon process?

      _____

10. Inspect and palpate the medial supracondylar ridge and medial epicondyle of the humerus.

    a. What are the three major actions of the muscles that originate from the medial supracondylar ridge and medial epicondyle?

        1) _____

        2) _____

        3) _____

11. Inspect and palpate the lateral supracondylar ridge and lateral epicondyle of the humerus.

    a. What are the three major actions of the muscles that originate from the lateral supracondylar ridge and lateral epicondyle?

        1) _____

        2) _____

        3) _____

12. Inspect and palpate the medial and lateral margins of the cubital fossa.

    a. What muscle forms the inferomedial border of the cubital fossa?

        _____

        1) What peripheral nerve provides motor innervation to this muscle?

            _____

    b. What muscle forms the inferolateral border of the cubital fossa?

        _____

1) What peripheral nerve provides motor innervation to that muscle?

_____

c. What artery lies on the floor of the cubital fossa?

_____

d. What vein lies superficial in the cubital fossa?

_____

e. The median nerve enters the forearm from the cubital fossa by passing between the two heads of origin of what muscle?

_____

f. The ulnar nerve enters the forearm from behind the medial epicondyle of the humerus by passing between the two heads of origin of what muscle?

_____

13. Inspect and palpate the muscles of the posterior compartment of the forearm.

a. Are the right and left sides visually symmetrical with regard to muscle bulk and contour?

_____

If not, describe the differences.

_____

b. Are the right and left sides symmetrical to palpation?

_____

If not, describe the differences.

_____

c. What peripheral nerve provides motor innervation to these muscles?

_____

14. Inspect and palpate the muscles of the anterior compartment of the forearm.

a. Are the right and left sides visually symmetrical with regard to muscle bulk and contour?

_____

b. Are the right and left sides symmetrical to palpation?

_____

If not, describe the differences.

_____

c. What peripheral nerves provide motor innervation to these muscles?

1) _____

2) _____

15. Palpate each of the following:

a. Head of the ulna

b. Pisiform bone

c. Styloid process of the radius

d. Dorsal (Lister's) tubercle of the radius

1) What tendon lies along the ulnar side of Lister's tubercle?

_____

16. At the level of the proximal wrist crease, identify and palpate the tendons of the

a. Flexor carpi radialis

b. Palmaris longus

c. Flexor carpi ulnaris

d. What artery lies on the radial side of the tendon of the flexor carpi radialis?

_____

e. What artery lies on the radial side of the tendon of the flexor carpi ulnaris?

_____

f. What nerve lies on the radial side of the tendon of the palmaris longus?

_____

17. Identify and inspect the transverse and longitudinal flexion creases of the palm.

18. Inspect and palpate the thenar and hypothenar eminences.

a. Are the right and left sides visually symmetrical with regard to muscle bulk and contour?

_____

If not, describe the differences.

_____

b. What three muscles form the bulk of the thenar eminence?

1) _____

2) _____

3) _____

c. What peripheral nerve provides motor innervation to these muscles?

_____

d. What three muscles form the bulk of the hypothenar eminence?

1) _____

2) _____

3) _____

e. What peripheral nerve provides motor innervation to these muscles?

_____

19. Identify and palpate the medial and lateral margins of the anatomical snuff box.

a. What muscle forms the medial (ulnar) border of the anatomical snuff box?

_____

b. What two muscles form the lateral (radial) border of the anatomical snuff box?

1) _____

2) _____

c. What artery lies on the floor of the anatomical snuff box?

_____

20. Inspect and palpate the bellies of the dorsal interossei between adjacent metacarpal bones.

a. Are the right and left sides visually symmetrical with regard to muscle bulk?

_____

If not, describe the differences.

_____

b. What is the action of the dorsal interossei?

_____

c. What nerve innervates the dorsal interossei?

_____

d. What is the action of the palmar interossei?

_____

e. What nerve innervates the palmar interossei?

_____

*B. Movement*

Instruct the subject to perform each of the following movements and to maintain the new position while you attempt to move the body part to the starting position. Examine the strength of both the right and left sides. Note the full range of motion permitted at each joint and the strength needed by the subject to resist your efforts to reposition the body part. In the spaces provided, list the main muscles responsible for each movement and indicate the peripheral nerve that innervates each muscle. With the subject in the sitting position ask the subject to:

| | MUSCLE | NERVE |
|---|---|---|
| 1. Elevate (shrug) the shoulders. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 2. Retract the shoulders (adduct the scapulae). | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |

| | MUSCLE | NERVE |
|---|---|---|
| 3. Flex the arm through the full range of motion. | | |
| a. | _____ | _____ |
| 4. Abduct the arm through the full range of motion. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 5. Adduct the abducted arm. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |
| d. | _____ | _____ |
| 6. Hyperextend the arm through the full range of motion. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 7. Flex the forearm (elbow) with the forearm supinated. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 8. Flex the forearm (elbow) with the forearm pronated. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 9. Extend the forearm (elbow) from the fully flexed position. | | |
| a. | _____ | _____ |

| | MUSCLE | NERVE |
|---|---|---|
| 10. Pronate the supinated forearm. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 11. Supinate the pronated forearm. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 12. Extend the wrist. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |
| 13. Flex the wrist. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 14. Deviate the wrist radialward. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |
| 15. Deviate the wrist ulnarward. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |

| | MUSCLE | NERVE |
|---|---|---|
| 16. Abduct the thumb. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 17. Adduct the thumb. | | |
| a. | _____ | _____ |
| 18. Flex the thumb. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 19. Extend the thumb. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |
| 20. Oppose the thumb and little finger. | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| 21. Flex the metacarpophalangeal joints of the medial four fingers. | | |
| a. | _____ | _____ |
| 22. Extend the metacarpophalangeal joints of the medial four fingers. | | |
| a. | _____ | _____ |

| | MUSCLE | NERVE |
|---|---|---|
| 23. Abduct the fingers. | | |
| a. | _____ | _____ |
| 24. Adduct the fingers. | | |
| a. | _____ | _____ |
| 25. Flex the fingers at the proximal interphalangeal (PIP) joints. | | |
| a. | _____ | _____ |
| 26. Flex the fingers at the distal interphalangeal (DIP) joints. | | |
| a. | _____ | _____ |
| 27. Extend the fingers at the PIP and DIP joints. | | |
| a. | _____ | _____ |

*C. Vasculature (Veins and Arteries)*

1. With the aid of an elastic tourniquet wrapped around the arm near the axilla, identify the following superficial veins throughout their course:
   a. Basilic vein (in the arm and forearm)
   b. Cephalic vein (in the arm and forearm)
   c. Median cubital vein
   d. Median antebrachial vein

2. Locate and palpate the following arterial pulses:

    a. Brachial artery in the arm

    b. Brachial artery in the cubital fossa

    c. Radial artery at the wrist

    d. Ulnar artery at the wrist

    e. Radial artery in the anatomical snuff box

*D. Nerves*

1. On the right upper limb of a subject, outline the area of skin innervated by nerve fibers comprising each of the following spinal dorsal roots:

    a. C5

    b. C6

    c. C7

    d. C8

    e. T1

2. An autonomous zone is an area of skin generally understood to be innervated exclusively by afferent (sensory) nerve fibers contained within a single pre-plexus spinal nerve root or post-plexus peripheral nerve. On the right upper limb, identify and mark the autonomous zone for each of the following spinal dorsal roots:

    a. C5

    b. C6

    c. C7

    d. C8

    e. T1

3. On the left upper limb of the same subject, outline the area of skin innervated by nerve fibers comprising each of the following peripheral nerves:

   a. Upper lateral brachial cutaneous nerve

   b. Lower lateral brachial cutaneous nerve

   c. Posterior brachial cutaneous nerve

   d. Medial brachial cutaneous nerve

   e. Lateral antebrachial cutaneous nerve

   f. Posterior antebrachial cutaneous nerve

   g. Medial antebrachial cutaneous nerve

   h. Median nerve in the hand

   i. Ulnar nerve in the hand

   j. Radial nerve in the hand

4. On the left upper limb identify and mark the autonomous zone for each of the following peripheral nerves:

   a. Axillary nerve

   b. Lateral antebrachial cutaneous nerve

   c. Deep radial nerve

   d. Median nerve

   e. Ulnar nerve

   f. Medial antebrachial cutaneous nerve

   g. Medial brachial cutaneous nerve

5. The brachial plexus passes from the root of the neck into the axilla by coursing over the top of the first rib between two muscles. These two muscles are:

   a. _____

   b. _____

# 3 Hip Girdle and Lower Limb

**Objectives**

1. Describe and identify by palpation in a living subject the major soft tissue and bony landmarks of the lower limb.

2. List the action and innervation of the major muscle groups of the lower limb.

3. List the major muscles responsible for movements permitted at each joint of the lower limb.

4. Identify the major ligaments of the lower limb and describe the movements limited or restricted by each.

5. Describe and identify by palpation in a living subject the major arterial pulses in the lower limb.

6. Identify and outline on a living subject, the area of skin innervated by each of the pre-plexus roots of the lumbosacral plexus.

7. Identify and outline on a living subject, the area of skin innervated by each of the post-plexus peripheral nerves of the lumbosacral plexus.

8. Describe the movements that would be affected as a result of lesions affecting the pre-plexus roots of the lumbosacral plexus.

9. Describe the movements that would be affected as a result of lesions affecting the post-plexus peripheral nerves of the lumbosacral plexus.

**Anatomy Review Questions**

1. What two bones form the pelvic girdle?

   a. _____

   b. _____

2. What three bones form the hip bone (os coxae or innominate bone)?

   a. _____

   b. _____

   c. _____

3. What are the three ligaments that form the capsule of the hip joint?

   a. _____

   b. _____

   c. _____

      1) Do these ligaments become taught in hip flexion or hip extension?

      _____

4. What are the two attachments of the inguinal ligament?

   a. lateral attachment _____

   b. medial attachment _____

5. What is the lateral attachment of the sacrotuberous ligament?

   _____

6. What is the lateral attachment of the sacrospinous ligament?

   _____

7. Describe the attachments and course of the anterior cruciate ligament.

_____

8. Describe the attachments and course of the posterior cruciate ligament.

_____

9. What ligament located on the medial side of the ankle resists pronation of the foot?

_____

10. What vein receives venous blood from the great saphenous vein?

_____

11. What vein receives venous blood from the small saphenous vein?

_____

12. What vein receives venous blood from the femoral vein?

_____

13. What two structures are encased in the femoral sheath?

a. _____

b. _____

14. What structure is located in the femoral canal?

_____

15. What structure marks the point where the external iliac artery becomes the femoral artery?

_____

16. At what point does the femoral artery become the popliteal artery?

_____

17. What are the two terminal branches of the popliteal artery?

a. _____

b. _____

18. What artery passes into the foot as the dorsal pedis artery?

_____

19. What spinal nerve roots contribute to the formation of the lumbar plexus?

_____ to _____

20. What are the two (2) major nerves of the lower limb derived from the lumbar plexus?

a. _____

b. _____

21. What spinal nerve roots contribute to the formation of the sacral plexus?

_____ to _____

22. What are the two (2) major nerves of the lower limb derived from the sacral plexus?

a. _____

b. _____

23 What nerve innervates the muscles of the posterior compartment of the leg?

_____

24. What nerve innervates the muscles of the anterior compartment of the leg?

_____

25. What nerve innervates the muscles of the lateral compartment of the leg?

_____

26. What nerve passes deep to the extensor retinaculum to innervate muscles of the foot?

_____

27. What nerve passes posterior to the medial malleolus to innervate muscles of the foot?

_____

28. What nerve passes through the adductor hiatus?

_____

29. What is the nerve that emerges from the adductor hiatus?

_____

a. Is this nerve a motor nerve, sensory nerve or a mixed nerve?

_____

30. What are the structures that mark the borders of the femoral triangle?

a. _____

b. _____

c. _____

31. Define the angle of inclination.

_____

a. What is the numerical value of the angle of inclination in the adult?

_____

32. Define the angle of declination.

_____

a. What is the numerical value of the angle of declination?

_____

33. Define the “Q” angle.

_____

a. What is the numerical value of the ”Q” angle?

_____

b. Is the “Q” angle greater or lesser in females than males?

_____

34. Which way does the tibia rotate on the femur during the last 150 of knee extension?

_____

35. Indicate whether the line of gravity falls anterior or posterior to each of the following joints.

a. hip joint _____

b. knee joint _____

c. ankle joint _____

36. In full knee extension, is the medial collateral ligament of the knee tight or slack?

_____

37. In full knee extension, is the lateral collateral ligament of the knee tight or slack?

_____

38. What ligament of the foot is referred to as the “spring ligament”?

_____

**Application Exercises**

*A. Inspection and Palpation*

With the subject resting comfortably in the supine position, perform the following:

1. Identify and palpate the greater trochanter.

2. Identify the location of the inguinal ligament by placing the tip of your long finger on the pubic tubercle and the tip of your thumb on the anterior superior iliac spine (Note: use your right hand when identifying the subject’s right inguinal ligament and left hand when identifying the left inguinal ligament.)

    a. What artery courses deep to the inguinal ligament midway between the anterior superior iliac spine and the pubic tubercle?

    _____

    b. What structure lies medial to the artery beneath the inguinal ligament?

    _____

c. What structure lies lateral to the artery passing deep to the inguinal ligament?

_____

d. What muscles form the borders of the femoral triangle?

1) _____

2) _____

3. Inspect and palpate the quadriceps femoris muscle. Pay particular attention to the distally located oblique fibers of the vastus medialis (VMO).

a. Are the right and left sides visually symmetrical with regard to muscle contour and bulk?

_____

If not, describe the differences.

_____

b. Which of the four heads of this muscle does NOT originate from the femur?

_____

c. What is the origin of this part of the quadriceps femoris?

_____

4. Instruct the subject to contract the quadriceps (forcefully extend the knee) while you palpate the distal part of the vastus medialis.

   a. Are the two sides symmetrical to palpation?

   _____

   If not, describe the differences.

   _____

   b. What effect does the action of this part of the quadriceps have on the patella?

   _____

5. Inspect and palpate the patellar ligament.

   a. What is the proximal attachment of this ligament?

   _____

   b. What is the distal attachment of this ligament?

   _____

6. Inspect and palpate the fibular head.

   a. What nerve lies along the posterior surface of the fibular head?

   _____

   b. What muscle originates on the fibular head?

   _____

7. Inspect and palpate the tibial tubercle and anterior tibial crest.

   a. What are the two (2) major actions of the muscles in the anterior compartment of the leg?

      1) _____

      2) _____

   b. What peripheral nerve lies within the anterior compartment of the leg?

      _____

   c. What artery lies in the anterior compartment of the leg?

      _____

8. Inspect and palpate the lateral malleolus and medial malleolus.

   a. What two muscles have tendons that lie posterior to the lateral malleolus?

      1) _____

      2) _____

9. Inspect the medial and lateral longitudinal arches of the foot.

   a. What is the most important ligament supporting the medial longitudinal arch?

      _____

10. Inspect the toes.

    a. Does the subject have hallux valgus? _____

    b. Does the subject have hammer toes? _____

With the subject lying comfortably in the supine position, slide one foot toward the buttock until the knee is flexed 90º. Keep the foot flat on the examination table.

11. Grasp the leg with both hands just below the knee and gently pull the tibia away from the buttock while keeping the foot immobile.

    a. What ligament prevents anterior displacement of the tibia on the femur?

    _____

    b. What is the tibial attachment of this ligament?

    _____

    c. What is the femoral attachment of this ligament?

    _____

12. Grasp the leg with both hands just below the knee and gently push the tibia toward the buttock while keeping the foot immobile.

    a. What ligament prevents posterior displacement of the tibia on the femur?

    _____

    b. What is the tibial attachment of this ligament?

    _____

c. What is the femoral attachment of this ligament?

_____

With the subject lying comfortably in the prone position, perform the following:

13. Palpate the iliac crests.

a. Which vertebra would be crossed by a line interconnecting the superior margins of the iliac crests?

_____

14. Palpate the ischial tuberosity.

a. What ligament attaches to the ischial tuberosity?

_____

b. What muscles originate from the ischial tuberosity?

1) _____

2) _____

3) _____

4) _____

15. The region of the “buttock” is commonly subdivided into four (4) regions: superolateral, inferolateral, superomedial and inferomedial. Intramuscular injections are administered in one of these regions. Indicate the region used for intramuscular injections and provide a brief explanation for why this region is preferred.

    a. Region _____

    b. Explanation _____

    _____

16. Inspect and palpate the posterior thigh (hamstring) muscles.

    a. Are the right and left sides visually symmetrical with regard to bulk and contour?

    _____

    If not, describe the differences.

    _____

    b. What is the major action of the posterior muscles of the thigh?

    _____

17. Inspect and palpate the popliteal fossa.

    a. What muscle forms the superolateral border of the popliteal fossa?

    _____

1) Which peripheral nerves provide motor innervation to this muscle?

a) _____

b) _____

b. What muscles form the superomedial border of the popliteal fossa?

1) _____

2) _____

3) What peripheral nerve provides motor innervation to these muscles?

_____

c. What muscle forms the inferomedial and inferolateral border of the popliteal fossa?

_____

1) What peripheral nerve provides motor innervation to this muscle?

_____

d. What artery lies on the floor of the popliteal fossa?

_____

e. What nerve lies in the popliteal fossa?

_____

f. What muscle forms the floor of the popliteal fossa?

_____

18. Inspect and palpate the posterior leg (crural) muscles.

a. Are the right and left sides visually symmetrical with regard to bulk and contour?

_____

If not, describe the differences.

_____

b. What are the major actions of the muscles of the posterior compartment of the leg?

1) _____

2) _____

c. What three muscles have tendons that lie posterior to the medial malleolus?

1) _____

2) _____

3) _____

With the subject standing with the feet approximately 6–8 inches apart and the toes parallel and directed forward:

19. Inspect the medial longitudinal arch of the foot.

a. Are the right and left arches symmetrical with regard to the height of the arch?

_____

If not, describe the differences.

_____

b. What muscle of the leg helps support the medial longitudinal arch of the foot?

_____

*B. Movements*

Instruct the subject to perform each of the following movements and to maintain the new position while you attempt to move the body part to the starting position. Examine movement and strength on both the right and left side. Note the full range of motion permitted at each joint and the strength needed by the subject to resist your efforts to reposition the body part. In the spaces provided, list the main muscles responsible for each movement and indicate the peripheral nerve that innervates each muscle.

With the subject in the sitting position instruct the subject to:

| | MUSCLE | NERVE |
|---|---|---|
| 1. Flex the thigh (hip joint) | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |
| 2. Extend the leg (knee joint) | | |
| a. | _____ | _____ |
| 3. Dorsiflex the foot (ankle joint) | | |
| a. | _____ | _____ |
| 4. Plantar flex the foot (ankle joint) | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |

| | MUSCLE | NERVE |
|---|---|---|
| 5. Extend the toes | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |
| 6. Flex the toes | | |
| a. | _____ | _____ |
| b. | _____ | _____ |

With the subject lying in the prone position instruct the subject to:

| | | |
|---|---|---|
| 7. Hyperextend the thigh (hip joint) | | |
| a. | _____ | _____ |
| 8. Flex the leg (knee joint) | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |

With the subject lying in the supine position, instruct the subject to:

| | | |
|---|---|---|
| 9. Adduct the abducted thigh (hip joint) | | |
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |

| | MUSCLE | NERVE |
|---|---|---|
| 10. Abduct the thigh (hip joint) | | |
| a. | _____ | _____ |
| b. | _____ | _____ |

*C. Vasculature (Veins and Arteries)*

1. Identify the location of the following superficial veins:
   a. great saphenous vein
   b. small saphenous vein
   c. popliteal vein
   d. femoral vein

2. Palpate the following arterial pulses:
   a. femoral artery at the level of the inguinal ligament
   b. popliteal artery
   c. anterior tibial artery at the ankle
   d. posterior tibial artery at the talus
   e. dorsal pedis artery in the foot

*D. Nerves*

1. On the right lower limb of a subject, outline the area of skin innervated by sensory nerve fibers comprising each of the following spinal dorsal roots:

    a. L2

    b. L3

    c. L4

    d. L5

    e. S1

    f. S2

2. On the right lower limb identify and mark the autonomous zone for each of the following spinal dorsal roots:

    a. L2

    b. L3

    c. L4

    d. L5

    e. S1

3. On the left lower limb of the same subject, outline the area of skin innervated by sensory nerve fibers comprising each of the following peripheral nerves:

    a. lateral femoral cutaneous nerve

    b. obturator nerve

    c. saphenous nerve

    d. superficial peroneal nerve

    e. sural nerve

    f. deep peroneal nerve

4. On the left lower limb identify and mark the autonomous zone for each of the following peripheral nerves:

   a. lateral femoral cutaneous nerve

   b. obturator nerve

   c. saphenous nerve

   d. superficial peroneal nerve

   e. sural nerve

   f. deep peroneal nerve

# 4 Thorax

**Objectives**

1. Describe and identify by palpation in a living subject the major bony and soft tissue landmarks of the thorax.

2. Describe and mark on a living subject the several “vertical lines” used to subdivide the thorax into definable regions.

**Anatomy Review Questions**

1. Name the three parts of the sternum.

   a. _____

   b. _____

   c. _____

2. What are the three structures that form the borders of the superior thoracic aperture?

   a. posterior border _____

   b. lateral border _____

   c. anterior border _____

3. What are the four structures that form the borders of the inferior thoracic aperture?

   a. posterior border _____

   b. posterolateral border _____

   c. anterolateral border _____

   d. anterior border _____

4. In the mid-axillary line, what is the fiber direction of the external intercostal muscles?

_____

5. In the mid-axillary line, what is the fiber direction of the internal intercostal muscles?

_____

6. Which rib serves as the insertion (inferior attachment) of each of the following?

   a. anterior scalene muscle _____

   b. middle scalene muscle _____

   c. posterior scalene muscle _____

7. What is the action of each of the muscles listed below?

   a. serratus posterior superior _____

   b. serratus posterior inferior _____

8. The external and internal intercostal muscles do fill the entire intercostal space from the vertebral column to the sternum—each forms an attachment by way of an intercostal membrane (i.e., external intercostal membrane and internal intercostal membrane). Which of these membranes is located in the:

   a. midclavicular line _____

   b. mid scapular line _____

9. Describe the location of the neurovascular structures within the intercostal space?

_____

10. What is the order (from superior to inferior) the three intercostal neurovascular structures?

    a. superior _____

    b. middle _____

    c. inferior _____

11. What is the origin of the anterior intercostal artery?

    _____

12. What is the termination of the anterior intercostal vein?

    _____

13. What is the origin of the internal thoracic artery on the right side?

    _____

14. What is the origin of the internal thoracic artery of the left side?

    _____

15. What are the two terminal branches of the internal thoracic artery?

    a. _____

    b. _____

16. Into what vein do the internal thoracic veins drain into?

    _____

17. What vessel does the azygos vein drain into?

    _____

18. What vessel does the hemiazygos vein drain into?

_____

19. What vessel does the accessory hemiazygos vein drain into?

_____

20. In the region of the superior thoracic aperture (thoracic inlet), what muscle separates the subclavian artery from the subclavian vein?

_____

**Application Exercises**

*A. Inspection and Palpation*

With the subject seated comfortably facing toward you

1. Inspect the sternum

    a. Is the body of the sternum flat or is it indented (pectus excavatum) or protruded (pectus carinatum)?

    _____

2. Palpate the suprasternal (jugular) notch and the sternoclavicular joints.

    a. What vertebral body would be crossed by a horizontal line extending posteriorly from the suprasternal notch?

    _____

3. Palpate the sternomanubrial joint (sternal angle or angle of Louis).

   a. What vertebral body would be crossed by a horizontal line extending posteriorly from the sternomanubrial joint?

   _____

   b. What rib attaches to the sternum at the sternal angle?

   _____

4. Palpate xiphoid process and xiphisternal joint.

   a. What vertebral body would be crossed by a horizontal line extending posteriorly from the xiphisternal joint?

   _____

   b. Which ribs attach to the sternum by way of their own individual costal cartilage (i.e., vertebrosternal ribs)?

   _____

   c. Which ribs attach to the sternum by way of a common costal cartilage (i.e., vertebrochondral ribs)?

   _____

5. Palpate the inferior margin of the costal cartilages starting at the xiphoid process and moving laterally.

   a. Which ribs attach only to the vertebral column (i.e., vertebral ribs)?

   _____

With the subject comfortably facing away from you

6. Inspect the vertebral column with respect to its position in the sagittal plane.

   a. Is the convexity of the thoracic spine directed anteriorly or posteriorly?

   _____

   b. What term is used to refer to an increase in the curvature of the thoracic spine in the sagittal plane?

   _____

7. Inspect the vertebral column with respect to its position in the coronal plane.

   a. Is the thoracic spine straight or do you see a curvature?

   _____

   b. If you see a curvature, is the convexity directed toward the right or left side?

   _____

   c. Is the lumbar spine straight or do you see a curvature?

   _____

   d. If you see a curvature, is the convexity directed toward the right or left side?

   _____

e. What term is used to refer to curvature of the spine in the coronal plane?

_____

8. Palpate the spinous process of C7 (vertebra prominens). (NOTE: sometimes the spinous process of T1 is prominent to palpation also.)

9. Palpate the supraspinous ligament from C7 to the sacrum, pressing hard enough to identify the thoracic and lumbar spinous processes.

10. With the subject sitting upright and the hands resting lightly on the thighs, palpate the vertebral border of the scapula from the superior angle to the inferior angle.

a. What rib lies immediately deep to the superior angle of the scapula?

_____

b. What rib lies immediately deep to the inferior angle of the scapula?

_____

*B. Landmarks*

1. The location of clinically important structures within the thorax is frequently described in relation to several vertical “lines” that subdivide the thoracic wall into definable regions. With the subject sitting upright and comfortable, identify and mark the following “lines” on the thorax:

    a. midsternal line

    b. midclavicular line

    c. anterior axillary line

    d. midaxillary line

    e. posterior axillary line

    f. midscapular line

    g. midspinal line

2. Indicate the fiber direction of the external intercostal muscle in the 5th intercostal space on the right side in the anterior axillary line.

    _____

3. Indicate the fiber direction of the internal intercostal muscle in the 5th intercostal space on the left side in the anterior axillary line.

    _____

4. What spinal (segmental) nerve provides sensory innervation to the skin of the nipple and areola?

    _____

# 5 Lungs and Pleura

**Objectives**

1. Describe and identify by palpation in a living subject the location of the pleural reflections on both sides.

2. Describe and identify by palpation in a living subject the location of the lung margins on both sides.

3. Describe and identify by palpation in a living subject the location of the fissures of each lung on both sides.

4. Describe and identify by palpation in a living subject the location of the landmarks on the anterior and posterior that mark the level of the tracheal bifurcation.

**Anatomy Review Questions**

1. What are the two divisions of the pleura?

   a. _____

   b. _____

2. What are the four parts of the parietal pleura?

   a. _____

   b. _____

   c. _____

   d. _____

3. Name the bronchopulmonary segments of each lung

a. Right lung

1) superior lobe _____

_____

_____

2) middle lobe _____

_____

3) inferior lobe _____

_____

_____

_____

_____

b. Left lung

1) superior lobe _____

_____

_____

_____

2) inferior lobe _____

_____

_____

_____

_____

4. Which lung is marked by a groove for the descending aorta?

_____

5. Which lung is marked by a groove for the azygos vein?

_____

6. The bifurcation of the trachea lies at a level marked by a horizontal line that passes through the

   a. _____ anteriorly

   b. _____ posteriorly

7. Because of its more vertical orientation and slightly greater diameter, an object aspirated into the trachea is more likely to pass into which main stem bronchus.

_____

8. Indicate the muscles that form the boundaries of the triangle of auscultation.

   a. superomedial boundary _____

   b. superolateral boundary _____

   c. inferior boundary _____

9. Which intercostal space forms the floor of the triangle of auscultation?

_____

10. Name the vertebra that marks the level of the following openings in the respiratory diaphragm.

    a. vena caval foramen _____

    b. esophageal hiatus _____

    c. aortic hiatus _____

11. List the structures that pass through the vena caval foramen.

_____

12. List the structures that pass through the esophageal hiatus.

a. _____

b. _____

13. List the structures that pass through the aortic hiatus.

a. _____

b. _____

c. _____

14. What nerve provides motor innervation to the respiratory diaphragm?

_____

15. What spinal segments give rise to the nerve indicated in the above question?

_____

**Application Exercises**

*A. Inspection and Palpation*

With the subject sitting comfortably with the hands resting lightly on the thighs:

1. Observe the movements of the chest during quiet breathing.

    a. Which phase of the respiratory cycle is longer during quiet breathing?

    _____

b. What is the normal respiration rate?

_____

2. Place the palm and fingers of one hand over the subject's xiphoid process and the other hand over the spinous processes of the T8-T10 vertebrae. Note the extent of chest expansion in the anterior-posterior direction during quiet breathing. Ask the subject to inhale deeply and exhale fully several times slowly and again note the extent of chest expansion in the anterior-posterior direction.

3. Place your hands over the 8th-10th ribs bilaterally in the midaxillary line. Note the extent of chest expansion in the transverse direction during quiet breathing. Ask the subject to inhale deeply and exhale fully several times slowly and again note the extent of chest expansion in the transverse direction.

*B. Landmarks*

With the subject sitting comfortably

1. Identify and mark the pleural reflections on the right and left sides of the thorax.

2. Indicate the rib overlying the pleural reflection in the

   a. midclavicular line _____

   b. midaxillary line _____

   c. midscapular line _____

3. Which costal cartilage marks the point where the pleural reflection moves laterally beneath the body of the sternum on the right side?

_____

4. Which costal cartilage marks the point where the pleural reflection moves laterally beneath the body of the sternum on the left side?

_____

5. Identify and mark the boundaries of the lungs on the right and left sides.

6. What rib overlies the lung boundary in the

   a. midclavicular line_____

   b. midaxillary line _____

   c. midscapular line_____

7. Which costal cartilage marks the point where the medial edge of the right lung moves laterally beneath the body of the sternum?

_____

8. Which costal cartilage marks the point where the medial edge of the left lung moves laterally beneath the body of the sternum?

_____

9. Identify and mark the location of the oblique fissure of the right and left lungs.

10. The oblique fissure lies parallel to a line interconnecting the

    a. _____ spinous process posteriorly

    b. _____ rib in the midaxillary line

    c. _____ costal cartilage anteriorly

11. Identify and mark the location of the horizontal fissure of the right lung.

12. The horizontal fissure lies parallel to a line interconnecting the

    a. _____ in the midaxillary line laterally

    b. _____ costal cartilage anteriorly

# 6 Heart

**Objectives**

1. Describe and mark in a living subject the location of the borders of the heart of the anterior chest wall.

2. Describe and mark in a living subject the location on the anterior chest wall of each of the cardiac valves.

3. Describe and mark in a living subject the location on the anterior chest wall of the best location for auscultating each of the cardiac valves.

4. Indicate the cardiac valves responsible for the S1 and S2 heart sounds.

**Anatomy Review Questions**

1. The superior border of the middle mediastinum is marked by a line that extends from the:

   a. _____ anteriorly

   b. _____ posteriorly

2. The inferior border of the middle mediastinum is marked by a line that extends from the:

   a. _____ anteriorly

   b. _____ posteriorly

3. What are the two layers of the pericardium?

   a. _____

   b. _____

4. What are the two layers of the serous pericardium?

   a. _____

   b. _____

5. Which layer of the heart is also referred to as the epicardium?

   _____

6. What are the two layers that enclose the pericardial cavity?

   a. _____

   b. _____

7. Through what cardiac valve does blood flow through to pass from the:

   a. right ventricle to the pulmonary artery _____

   b. left ventricle to the aorta _____

   c. left atrium to the left ventricle _____

   d. right atrium to the right ventricle _____

8. Which chambers of the heart are separated by the fossa ovalis?

   a. _____

   b. _____

9. In the fetus, in which direction does blood flow through the ductus arteriosus?

   _____

10. Into which chamber of the heart does the coronary sinus drain?

    _____

11. In which chamber of the heart are pectinate muscles located?

_____

12. In which two (2) chambers of the heart are papillary muscles located?

a. _____

b. _____

13. What structures serve to attach papillary muscles to cardiac valve leaflets?

_____

14. What are the two (2) major named branches of the left coronary artery?

a. _____

b. _____

15. What are the two major named branches of the right coronary artery?

a. _____

b. _____

16. What are the five main veins that drain into the coronary sinus?

a. _____

b. _____

c. _____

d. _____

e. _____

17. What coronary veins do NOT drain into the coronary sinus?

_____

18. What is the location of the parasympathetic nerve cell bodies that innervate the heart?

a. preganglionic cell _____

1) What is the neurotransmitter used by this cell?

_____

b. postganglionic cell _____

1) What is the neurotransmitter used by this cell?

_____

19. What is the location of the sympathetic nerve cell bodies that innervate the heart?

a. preganglionic cell _____

1) What is the neurotransmitter used by this cell?

_____

b. postganglionic cell _____

1) What is the neurotransmitter used by this cell?

_____

20. What are the three vessels (in order) that arise from the arch of the aorta?

a. _____

b. _____

c. _____

21. Which pulmonary vein passes under the arch of the aorta?

_____

## Application Exercises

*A. Landmarks*

With the subject sitting comfortably facing you

1. Identify and mark the borders of the heart on the anterior thorax

    a. superior border – draw a line from the inferior margin of the 2nd costal cartilage on the left to the inferior margin of the 2nd costal cartilage on the right. The line should extend from the left sternal border to the right sternal border.

    b. right border – draw a line from the 2nd costal cartilage on the right to the 6th costal cartilage on the right. The line should have a slight convexity toward the right as it courses inferiorly, approximately 1 cm lateral to the lateral sternal border.

    c. inferior border – draw a line from the 6th costal cartilage on the right side beginning at the lateral sternal border to the 5th intercostal space on the left side in the midclavicular line.

    d. left border – draw a line from the 5th intercostal space on the left side in the midclavicular line to the 2nd costal cartilage on the left along the lateral sternal border.

2. Identify and mark the anatomical location of the valves of the heart.

    a. pulmonary valve – lies posterior to the 3rd sternochondral junction on the left side

    b. aortic valve – lies in the midsternal line at the level of the 3rd intercostal space

c. mitral valve – lies posterior to the 4th sternochondral junction on the left side

d. tricuspid valve – lies in the midsternal line at the level of the 5th sternochondral junction

3. Identify and mark on the anterior chest wall, sites for auscultating each of the cardiac valves

a. aortic valve – 2nd intercostal space on the right side along the lateral sternal border

b. pulmonary valve – 2nd intercostal space on the left side along the lateral sternal border

c. tricuspid valve – 5th intercostal space on the left side along the lateral sternal border

d. mitral valve – 5th intercostal space on the left side on or near the midclavicular line

*B. Inspection and Palpation*

With the subject lying comfortably in the supine position with the head and upper thorax slightly elevated

1. Observe the apical impulse

a. Describe the location of the apical impulse

_____

2. While standing on the subject's right side, use your right hand to palpate the point of maximum impulse (PMI)

   a. Describe the location of the PMI.

   _____

   b. What is the subject's heart rate?

   _____

*C. Auscultation*

The cardiac cycle consists of two phases: systole and diastole. During systole the left and right ventricles contract, ejecting blood into the aorta and pulmonary artery, respectively. The onset of systole is marked by closure of the mitral and tricuspid valves (atrioventricular valves). Closure of these valves prevents reflux into the atria and gives rise to the 1st heart sound (S1). The end of systole (or beginning of diastole) is marked by closure of the aortic and pulmonary valves (semilunar valves). Closure of these valves prevents reflux into the left and right ventricles respectively and gives rise to the second heart sound (S2).

With the subject lying comfortably in the supine position with the head and upper thorax slightly elevated

1. Use your stethoscope to auscultate each of the heart valves individually. Which heart sound is loudest or most clearly heard over each valve projection area?

   a. aortic area _____

   b. tricuspid area _____

   c. pulmonary area _____

   d. mitral area _____

2. In your resting subject, which phase of the cardiac cycle is shorter?

   _____

# 7 Abdomen

**Objectives**

1. Describe and identify by palpation in a living subject the margins of the abdominal wall.

2. Describe and mark in a living subject the lines used to divide the abdomen into four (4) quadrants.

3. List the organs and other important anatomical structures commonly located in each of the four quadrants.

4. Describe and mark in a living subject the lines used to divide the abdomen into nine (9) regions.

5. List the organs and other important anatomical structures commonly located in each of the nine regions.

**Anatomy Review Questions**

1. Below the level of the umbilicus, what are the two layers of superficial fascia?

   a. _____

   b. _____

2. What is the name of the layer of fascia that lies deep to the transversus abdominus muscle?

   _____

3. The neurovascular structures of the abdominal wall lie between which two muscle layers of the abdominal wall?

   a. _____

   b. _____

4. Above the level of the arcuate line, what structures form the:

   a. anterior wall of the rectus sheath

      _____

   b. posterior wall of the rectus sheath

      _____

5. Below the level of the arcuate line, what structures form the:

   a. anterior wall of the rectus sheath

      _____

   b. posterior wall of the rectus sheath

      _____

The lower part of the anterior abdominal wall receives arterial blood supply from both the distal part of the external iliac artery and the proximal part of the femoral artery.

6. What are the two branches of the external iliac artery that supply the anterior abdominal wall?

   a. _____

   b. _____

7. What are the two branches of the femoral artery that supply the anterior abdominal wall?

   a. _____

   b. _____

8. What structure gives rise to the:

   a. median umbilical fold _____

   b. medial umbilical fold _____

   c. lateral umbilical fold _____

9. What structure invaginates to form the deep (internal) inguinal ring?

   _____

10. What structure splits to form the superficial (external) inguinal ring?

    _____

11. Which abdominal muscle gives rise to the cremaster muscle?

    _____

12. What structure (layer) of the abdominal wall gives rise to the:

    a. external spermatic fascia _____

    b. internal spermatic fascia _____

    c. tunica vaginalis _____

13. What part of the stomach lies between the body of the stomach and the distal esophagus?

    _____

14. What part of the stomach lies between the body of the stomach and the duodenum?

    _____

15. What are the three major branches of the celiac trunk?

a. _____

b. _____

c. _____

16. What two arteries anastomose on the lesser curvature of the stomach?

a. _____

b. _____

17. What two arteries anastomose on the greater curvature of the stomach?

a. _____

b. _____

18. What artery is the origin of the short gastric arteries?

_____

19. What artery is the usual origin of the cystic artery?

_____

20. What two vessels form the portal vein?

a. _____

b. _____

21. Into what vein does the inferior mesenteric vein drain?

_____

22. What are the four parts of the duodenum? (List in order from proximal to distal.)

a. _____

b. _____

c. _____

d. _____

23. What two structures commonly merge and drain into the duodenum by way of the major duodenal papilla?

a. _____

b. _____

24. Into what part of the duodenum does the major duodenal papilla drain?

_____

25. Where and what is the “sphincter of Oddi”?

_____

26. Where and what is the “ampulla of Vater”?

_____

27. Which of the four parts of the duodenum is supported by the suspensory ligament of the duodenum (ligament of Treitz)?

_____

28. The superior mesenteric artery passes superficial to which part of the duodenum in order to supply the structures of the foregut?

_____

29. What part of the large intestine (colon) serves as the attachment for the appendix?

_____

30. Which three parts of the colon are typically supplied by branches of the superior mesenteric artery?

a. _____

b. _____

c. _____

31. Which two parts of the colon are typically supplied by branches of the inferior mesenteric artery?

a. _____

b. _____

32. What two structures fuse to form the bile duct?

a. _____

b. _____

33. What three structures comprise the portal triad?

a. _____

b. _____

c. _____

34. Indicate the vertebral level of each of the following:

a. bifurcation of the aorta _____

b. pyloric valve of the stomach _____

c. the inferior vena cava _____

d. origin of the inferior mesenteric artery _____

e. origin of the renal arteries _____

f. superior mesenteric artery _____

35. Which renal vein is the longer of the two?

_____

36. Which renal vein is crossed by the superior mesenteric artery?

_____

37. What structure is the origin of the thoracic duct?

_____

38. What vascular structure does the thoracic duct drain into?

_____

39. Describe the location of McBurney's point.

_____

**Application Exercises**

*A. Inspection*

With the subject lying comfortably in the supine position:

1. Inspect the anterior abdominal wall

   a. Is it flat or distended? _____

   b. Are there scars or bruises? _____

      If so, describe the location, size, length, direction and apparent age.

      _____

      _____

   c. Are there dilated veins visible? _____

      If so, describe their location and orientation.

      _____

      _____

2. Inspect the umbilicus.

   a. Is the umbilicus in the midline? _____

   b. Is the umbilicus inverted or everted? _____

3. Inspect the skin overlying the rectus abdominis muscle. Ask the subject to cross the arms over the chest and attempt to lift the shoulders off the table.

   a. Can you see the lateral borders of the rectus abdominis?

      _____

b. Are the tendinous intersections above or below the umbilicus?

_____

*B. Palpation and Landmarks*

1. Palpate and mark the xiphoid process.

2. Palpate the inferior margin of the costal cartilages of ribs 6-10. Begin medially at the xiphoid process and move laterally along the costochondral margin until you feel the anterior end of the 11th rib. Mark this border of the anterior abdominal wall on both sides with a line extending from the xiphoid process to the inferior margin of the 11th rib in the midaxillary line.

3. Palpate the iliac crests on both sides. Begin laterally in the midaxillary line and move anteriorly until you reach the anterior superior iliac spine (ASIS). Mark this border of the ilium with a line extending from the iliac crest in the midaxillary line to the anterior superior iliac spine on both sides.

4. Palpate the inguinal ligament from its superolateral attachment on the anterior superior iliac spine to its inferomedial attachment on the pubic tubercle. Mark this inferior border of the anterior abdominal wall with a line extending from the anterior superior iliac spine (ASIS) to the pubic tubercle.

5. Using proper technique, palpate the free edge of the liver.

    a. Describe the location on the anterior abdominal wall where you would palpate the free margin of the liver.

    _____

The anterior abdominal wall can be divided into four regions or nine regions by a series of vertical and horizontal lines that intersect identifiable anatomical landmarks. Anatomical landmarks associated with both systems will be identified below.

The Four Region System

6. Mark a vertical line from the xiphoid process to the pubic symphysis that passes through the umbilicus.

7. Mark a horizontal line that passes through the umbilicus (transumbilical line). These two lines define four quadrants identified as the right upper quadrant (RUQ), left upper quadrant (LUQ), right lower quadrant (RLQ) and left lower quadrant (LLQ).

   a. In a thin subject, what vertebra would be intersected by a horizontal line that extends posteriorly from the umbilicus?

      _____

8. List the organs or other important anatomical structures commonly located in each quadrant. (Fill in one structure for each line provided.)

   a. RUQ: _____ _____

      _____ _____

      _____ _____

      _____ _____

      _____ _____

b. LUQ: _____ _____

_____ _____

_____ _____

_____ _____

_____ _____

c. RLQ: _____ _____

_____ _____

_____ _____

_____ _____

_____ _____

d. LLQ: _____ _____

_____ _____

_____ _____

_____ _____

9. Mark vertical lines on both sides of the abdomen from the costal cartilage to the inguinal ligament in the midclavicular line.

10. Mark a horizontal line that passes between the lowest extent of the costal cartilages on each side (subcostal line).

    a. What vertebrae would be intersected by a horizontal line extending posteriorly from the subcostal line?

    _____

    b. Name the three regions of the anterior abdominal wall that lie above the subcostal line.

        1) _____

        2) _____

        3) _____

11. Mark a horizontal line that passes between the iliac tubercles (transtubercular line).

    a. What vertebrae would be intersected by a horizontal line extending posteriorly from the transtubercular line?

    _____

    b. Name the three regions of the anterior abdominal wall that lie above the transtubercular line and below the subcostal line.

        1) _____

        2) _____

        3) _____

c. Name the three regions of the anterior abdominal wall that lie below the transtubercular line.

1) _____

2) _____

3) _____

12. Mark a line from the umbilicus to the right anterior superior iliac spine (ASIS). McBurney's point lies on this line, two thirds the distance from the umbilicus to the ASIS.

13. What spinal (segmental) nerve provides sensory innervation to the skin of the umbilicus?

_____

14. On the right side of the anterior abdominal wall indicate the fiber direction of the external oblique muscle.

_____

15. On the left side of the anterior abdominal wall indicate the fiber direction of the internal oblique muscle.

_____

*C. Auscultation*

With the subject lying comfortably in the supine position, perform the following:

1. Use your stethoscope to auscultate each of the four quadrants of the anterior abdominal wall. Listen for approximately three minutes in each quadrant.

    a. Did you hear something in each quadrant?

    _____

    b. Describe the sounds you heard.

    _____

    _____

    c. What is *borborygmy*?

    _____

2. Place your stethoscope on the abdomen in the places where you would best hear bruits of the following vessels and describe that location.

    a. aorta

    _____

    b. renal artery

    _____

    c. common iliac artery

    _____

# 8 Head and Face

**Objectives**

1. Describe the anatomical features of the face commonly inspected when evaluating the face.

2. Describe the major movements of the face used when testing the motor function of the facial nerve. Indicate the muscles producing each movement.

3. Describe and identify by palpation in a living subject the area of skin innervated by each major branch of the trigeminal nerve.

4. Demonstrate in a living subject the major palpable arterial pulses of the face.

5. Describe the anatomical organization of autonomic innervation to smooth muscle and glandular structures of the face.

**Anatomy Review Questions**

1. What bones are joined to form the lambda?

   a. _____

   b. _____

2. What bones are joined to form the bregma?

   a. _____

   b. _____

3. What two bones contribute to the zygomatic arch?

   a. _____

   b. _____

4. What four bones contribute to the formation of the pterion?

   a. _____

   b. _____

   c. _____

   d. _____

5. At approximately what age does the anterior fontanelle become no longer palpable?

   _____

6. What structure divides the intracranial compartment into right and left halves?

   _____

7. What structure divides the intracranial compartment into supratentorial and infratentorial compartments?

   _____

8. What are the five layers of the scalp?

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

9. What branch of the external carotid artery:

   a. is palpable along the inferior border of the mandible?

   _____

   b. supplies the structure of the tongue?

   _____

   c. is palpable in the temporal fossa?

   _____

   d. supplies part of the thyroid gland?

   _____

   e. enters the pterygopalatine fossa?

   _____

10. What artery anastomoses from the front with the intraorbital branches of the ophthalmic artery?

    _____

11. What dural venous sinus:

   a. lies in the superior margin of the falx cerebri?

   _____

   b. lies in the inferior margin of the falx cerebri?

   _____

c. lies along the petrous ridge?

_____

d. lies immediately lateral to the sella turcica?

_____

12. Which two dural venous sinuses drain directly into the jugular vein?

a. _____

b. _____

13. What artery enters the cranial cavity by passing through the foramen magnum?

_____

14. What artery enters the cranial cavity by passing through the foramen spinosum?

_____

15. What two arteries are connected by way of the anterior communication artery?

a. _____

b. _____

16. What two arteries are connected by way of the posterior communication artery?

a. _____

b. _____

17. What are the five major intracranial branches of the internal carotid artery?

    a. _____

    b. _____

    c. _____

    d. _____

    e. _____

18. What cranial nerve passes through the parotid gland?

    _____

19. What are the four muscles of mastication?

    a. _____

    b. _____

    c. _____

    d. _____

20. What cranial nerve mediates sensation from the

    a. forehead over the eyebrows?

    _____

    b. skin over the maxilla?

    _____

    c. skin over the mental tubercle?

    _____

21. What cranial nerve provides parasympathetic innervation to the parotid gland?

_____

a. What is the location of the postganglionic cell body?

_____

22. What cranial nerve provides parasympathetic innervation to the submandibular and submaxillary glands?

_____

a. What is the location of the postganglionic cell body?

_____

23. What cranial nerve provides parasympathetic innervation to the lacrimal gland?

_____

a. What is the location of the postganglionic cell body?

_____

24. What cranial nerve provides motor innervation to the muscles of facial expression?

_____

25. What cranial nerve provides motor innervation to the muscles of mastication?

_____

26. What cranial nerve provides sensory innervation to the face?

_____

a. What branch of this nerve innervates the skin over the eyebrow?

_____

1) Which opening in the middle cranial fossa contains the axons of this nerve branch?

_____

b. What branch of this nerve innervates the skin over the maxilla?

_____

1) Which opening in the middle cranial fossa contains the axons of this nerve branch?

_____

c. What branch of this nerve innervates the skin over the mental protuberance?

_____

1) Which opening in the middle cranial fossa contains the axons of this nerve branch?

_____

27. What foramen transmits the axons of the glossopharyngeal nerve?

_____

28. What striated (skeletal) muscle is innervated by the glossopharyngeal nerve?

_____

29. What special sensory functions are mediated by the glossopharyngeal nerve?

a. _____

b. _____

30. What foramen transmits the axons of the vagus nerve?

_____

31. What striated muscles are innervated by the vagus nerve?

a. _____

b. _____

32. What is the effect of the vagus nerve on heart rate?

_____

33. What is the effect of the vagus nerve on gastric and intestinal motility?

_____

34. What special sensory functions are mediated by the vagus nerve?

a. _____

b. _____

35. What two foramina transmit the axons of the spinal accessory nerve?

a. _____

b. _____

36. What muscles are innervated by the spinal accessory nerve?

    a. _____

    b. _____

37. What foramen transmits the axons of the hypoglossal nerve?

    _____

38. What muscle innervated by the hypoglossal nerve is primarily involved in protrusion of the tongue?

    _____

39. What cranial nerve exits the skull via the stylomastoid foramen?

    _____

40. Through what foramen does the facial nerve enter the skull (exit the posterior cranial fossa)?

    _____

41. Through what foramen does the facial nerve exit the skull?

    _____

42. What are the five terminal branches of the facial nerve that emerge from the substance of the parotid gland?

    a. _____

    b. _____

    c. _____

    d. _____

    e. _____

43. What two nerves form the nerve of the pterygoid canal (Vidian nerve)?

a. _____

b. _____

44. What cranial nerve gives rise to the chorda tympani?

_____

45. What cranial nerve gives rise to the greater superficial petrosal nerve?

_____

46. What cranial nerve gives rise to the tympanic nerve?

_____

**Application Exercises**

*A. Inspection and Palpation*

With the subject seated comfortably facing you:

1. Inspect the position of the head with respect to the neck.

a. Is the head in the midline? _____

If not, is it tilted forward or backward, to the right or left, or rotated (face turned) to the right or left? _____

Describe.

_____

_____

b. Is the head held steady or do you see movement?

_____

If you see movement, please describe.

_____

2. Palpate the external occipital protuberance.

a. What dural venous sinus lies deep to the external occipital protuberance?

_____

3. Palpate each of the following bony landmarks.

a. glabella

b. nasion

c. zygomatic arch

d. mental protuberance and tubercles

e. angle of the mandible

f. mastoid process

Instruct the subject to relax the face and gaze forward.

4. Inspect the skin of the forehead.

a. Do you see wrinkles?

_____

If so, on which side or both?

_____

5. Inspect the eyebrows.

a. Are they at the same level?

_____

If not, which side is higher?

_____

6. Inspect and measure the height of both palpebral fissures.

a. Are they the same height on both sides?

_____

If not:

What is the height on the right side?

_____

What is the height on the left side?

_____

b. What muscle elevates the upper eyelid?

_____

1) What cranial nerve innervates this muscle?

_____

c. Does the upper lid on either side cover the pupil?

_____

If so, on which side or both?

_____

d. Does the upper lid on either side cover the iris?

_____

If so, on which side or both?

_____

e. Does the lower lid on either side cover the iris?

_____

If so, on which side or both?

_____

f. Do you see more sclera below the iris on one side or the other?

_____

If so, on which side do you see more sclera?

_____

g. Is the edge of the lower lid touching the eye?

_____

If not, is the lower lid everted (ectropion) or inverted (entropion)?

_____

1) Weakness of what muscle causes ectropion?

_____

2) What cranial nerve innervates this muscle?

_____

7. Inspect the pupils in ambient room light.

a. Are they identical in diameter?

_____

If not, what are their diameters?

right pupil _____

left pupil _____

8. Inspect the conjunctiva of the upper and lower eyelids. Describe its color.

_____

9. Inspect the nasolabial folds on each side.

a. Do they appear symmetrical in terms of shape and depth?

_____

If not, describe the difference between the two sides.

_____

10. Inspect the upper and lower lips.

a. Are the right and left sides symmetrical?

_____

If not, describe the difference.

_____

11. Inspect the corners of the mouth.

    a. Are the right and left sides symmetrical?

    _____

    If not, describe the differences.

    _____

12. Inspect the color of the face.

    a. Is one side redder (hyperemic) than the other?

    _____

    If so, which side?

    _____

13. With aid of a pen light, inspect the nasal cavity

    a. Is the septum in the midline?

    _____

    If not, describe its position.

    _____

*B. Movement*

1. Ask the subject to “Raise your eyebrows” or “Look up to the ceiling.”

a. What muscle is used to raise the eyebrows?

_____

b. What cranial nerve innervates this muscle?

_____

c. Do symmetrical wrinkles appear on both sides the forehead?

_____

If not, describe the differences.

_____

2. Ask the subject to “Close both eyes tightly.”

a. What muscle is used to close the eyes tightly?

_____

b. What cranial nerve innervates this muscle?

_____

c. Do both eyes close symmetrically?

_____

d. Describe Bell’s phenomenon.

_____

_____

3. Ask the subject to “Smile to a friend” or “Show me your teeth.”

   a. What muscle is used to retract the corners of the mouth?

   _____

   b. What cranial nerve innervates this muscle?

   _____

   c. Do both corners of the mouth move symmetrically to the sides?

   _____

   If not, describe the differences.

   _____

4. Ask the subject to “Purse the lips as if to whistle or kiss someone.”

   a. What muscle is used to purse the lips?

   _____

   b. What cranial nerve innervates this muscle?

   _____

5. Place your fingers immediately anterior to the tragus on both sides and palpate the movement of the condyle of the mandible as the subject opens and closes the mouth.

   a. Is the movement smooth and symmetrical?

   _____

   If not, describe what you feel.

   _____

6. Ask the subject to alternately clench the teeth and relax the bite while you palpate the temporalis and then masseter muscles.

   a. What two muscles are used to clench the teeth?

      1) _____

      2) _____

   b. What cranial nerve innervates these muscles?

      _____

*C. Vasculature*

1. Palpate pulsations of the superficial temporal artery immediately anterior to the tragus on each side.

   a. Is the superficial temporal artery a branch of the internal or external carotid artery?

      _____

2. Palpate pulsations of the superficial temporal artery in the temporal fossa between the top of the ear and the lateral margin of the eyebrow.

3. Palpate pulsations of the facial artery over the body of the mandible between the angle and the mental tubercle.

   a. Is the facial artery a branch of the internal or external carotid artery?

      _____

# 9 Neck

**Objectives**

1. Describe and identify by palpation in a living subject the major anatomical structure of the anterior and lateral neck.

2. Identify and mark in a living subject the borders and margins of the anterior and posterior triangles of the neck, including the smaller triangles within each.

3. Identify and describe the anatomical structures commonly located within each of the triangles of the neck.

**Anatomy Review Questions**

1. What are the four parts of the deep cervical fascia?

   a. _____

   b. _____

   c. _____

   d. _____

2. What two muscles are ensheathed by the investing layers of the deep cervical fascia?

   a. _____

   b. _____

3. What four structures are enclosed within the pretracheal layer of deep cervical fascia?

   a. _____

   b. _____

   c. _____

   d. _____

4. What are the three main structures enclosed within the carotid sheath?

   a. _____

   b. _____

   c. _____

5. What are the boundaries of the anterior triangle of the neck?

   a. _____

   b. _____

   c. _____

6. What are the boundaries of the carotid triangle?

   a. _____

   b. _____

   c. _____

7. What are the boundaries of the submandibular triangle?

   a. _____

   b. _____

   c. _____

8. What are the boundaries of the submental triangle?

   a. _____

   b. _____

   c. _____

9. What muscles are boundaries of the muscular triangle?

   a. _____

   b. _____

   c. _____

10. What are the boundaries of the posterior triangle of the neck?

   a. _____

   b. _____

   c. _____

11. What muscles comprise the infrahyoid muscles of the neck?

   a. _____

   b. _____

   c. _____

   d. _____

12. What muscles comprise the suprahyoid muscles of the neck?

   a. _____

   b. _____

   c. _____

   d. _____

13. What muscle abducts the vocal folds?

_____

14. What nerve provides motor innervation to this muscle?

_____

15. What two muscles adduct the vocal folds?

a. _____

b. _____

16. What nerve provides motor innervation to these muscles?

_____

17. What laryngeal muscle lies on the external surface of the larynx?

_____

18. What nerve provides motor innervation to this muscle?

_____

19. What nerve provides sensory innervation to the mucosal lining the internal surface of the larynx?

_____

20. The roots of the brachial plexus course through the root of the neck by passing between which two of the scalene muscles?

a. _____

b. _____

21. The subclavian artery courses through the root of the neck by passing

_____ to the anterior scalene muscle

22. The subclavian vein courses through the root of the neck by passing

_____ to the anterior scalene muscle

23. What is the anatomical landmark that marks the point where the subclavian artery becomes the axillary artery?

_____

24. What are the four branches of the subclavian artery?

a. _____

b. _____

c. _____

d. _____

25. What artery is the origin of the superior thyroid artery?

_____

26. What artery is the origin of the inferior thyroid artery?

_____

27. What veins merge to form the retromandibular vein?

a. _____

b. _____

28. What veins merge to form the external jugular vein?

    a. _____

    b. _____

29. What veins merge to form the brachiocephalic vein?

    a. _____

    b. _____

30. What spinal segments give rise to the phrenic nerve?

    _____

31. What spinal segments give rise to the ansa cervicalis?

    _____

32. At what vertebral level does the common carotid artery bifurcate to form the internal and external carotid arteries?

    _____

33. Sympathetic chain ganglia from what segmental levels fuse to form the superior cervical ganglion?

    _____

34. Sympathetic chain ganglia from what segmental levels fuse to form the middle cervical ganglion?

    _____

35. Sympathetic chain ganglia from what segmental levels fuse to form the inferior cervical ganglion?

    _____

**Application Exercises**

*A. Inspection and Palpation*

With the subject seated comfortably facing you:

1. Inspect neck from the mastoid process and body of the mandible above to the clavicle and suprasternal notch below.

   a. Are the two sides visually symmetrical?

   _____

   If not, describe.

   _____

   b. Do you see any masses, swelling or pulsations?

   _____

   If so, describe.

   _____

2. Palpate the anterior edge of the sternocleidomastoid muscle from its superior attachment on the mastoid process to its inferior attachment on the clavicle and manubrium. Identify the anterior triangle of the neck.

   a. List the borders of the anterior triangle of the neck.

      1) _____

      2) _____

      3) _____

With the subject seated comfortably facing away from you:

3. Palpate the angle of the mandible. Move your fingers anteriorly along the inferior margin of the body of the mandible toward the mental protuberance.

4. Slide your fingers inferiorly from the body of the mandible and gently palpate the body and greater horns of the hyoid bone.

   a. What is the vertebral level of the hyoid bone?

      _____

5. Slide your fingers inferiorly in the anterior midline below the hyoid bone and gently palpate the thyroid notch, laryngeal prominence and intervening thyrohyoid membrane.

   a. What is the vertebral level of the thyroid notch?

      _____

6. With your fingers on the laryngeal prominence, ask the subject to swallow.

   a. Which direction does the thyroid cartilage move?

      _____

7. Slide your fingers inferiorly in the anterior midline below the thyroid cartilage and gently palpate the cricoid cartilage and intervening cricothyroid membrane.

   a. What is the vertebral level of the cricoid cartilage?

      _____

8. Slide your fingers inferiorly in the anterior midline below the cricoid cartilage and gently palpate the trachea in the space above the suprasternal (jugular) notch. Can you feel the isthmus of the thyroid gland where it lies over the 2–4 tracheal rings? If not, ask the subject to swallow, causing the trachea and overlying thyroid isthmus to move upward beneath your fingertips.

   a. List the four infrahyoid muscles:

      1) _____

      2) _____

      3) _____

      4) _____

9. Palpate the neck along the anterior margin of the sternocleidomastoid muscle from the manubrium to the mastoid process and along the posterior and inferior margins of the mandible from the auricle to the mental protuberance.

   a. Do you feel any swollen lymph nodes?

      _____

      If so, are they tender to palpation?

      _____

10. Palpate the external occipital protuberance. Then slide your fingers inferiorly along the ligamentum nuchae toward vertebra prominens.

   a. Vertebra prominens in the spinous process of which vertebra?

      _____

11. Palpate the anterior border of the trapezius and the posterior border of the sternocleidomastoid from their superior attachments on the skull to their inferior attachments on the clavicle.

a. List and mark the three boundaries of the posterior triangle of the neck.

1) _____

2) _____

3) _____

b. Mark the course of the spinal accessory nerve as it courses toward the trapezius across the floor of the posterior triangle.

c. What four muscles form the floor of the posterior triangle of the neck?

1) _____

2) _____

3) _____

4) _____

d. What is the action of the sternocleidomastoid muscle on the head?

_____

12. Palpate the neck along the posterior margin of the sternocleidomastoid muscle from clavicle to the occipital bone.

a. Do you feel any swollen lymph nodes?

_____

If so, are they tender to palpation?

_____

*B. Vasculature*

With the subject sitting comfortably facing you:

1. Palpate pulsations of the common carotid artery in the space between the thyroid cartilage and the sternocleidomastoid muscle.

   a. At what vertebral level does the common carotid artery bifurcate?

   _____

2. Palpate pulsations of the internal carotid artery immediately deep to the angle of the mandible.

   a. What nerve lies within the carotid sheath along with the carotid artery?

   _____

   b. What other structure lies within the carotid sheath?

   _____

3. Palpate pulsations of the common carotid in the space between the cricoid cartilage and the sternocleidomastoid muscle.

   a. What bony structure lies immediately posterior to the common carotid artery at this level?

   _____

   b. What is the heart rate of your subject?

   _____

# 10 Mouth and Pharynx

**Objectives**

1. Identify and describe by inspection in a living subject the major structures and anatomical landmarks of the oral cavity and oropharynx.

2. Indicate the nervous innervation of the various structures and regions of the oral cavity and oropharynx.

3. Describe the sensory and motor innervation of the tongue and the tonsillar fossa.

**Anatomy Review Questions**

1. What are the two main muscles used to close the mouth?

   a. _____

   b. _____

2. What muscle forms the floor of the oral cavity?

   _____

3. What muscle forms the palatoglossal arch?

   _____

   a. What nerve provides motor innervation to this muscle?

      _____

4. What muscle forms the palatopharyngeal arch?

   _____

a. What nerve provides motor innervation to this muscle?

_____

5. What muscle forms the anterior pillar of the tonsillar fossa?

_____

6. What muscle forms the posterior pillar of the tonsillar fossa?

_____

7. What nerve provides sensory innervation to the mucosal lining of the tonsillar fossa?

_____

8. What two muscles act on the soft palate?

a. _____

b. _____

9. What nerve provides motor innervation to the superior, middle and inferior pharyngeal constrictor muscles?

_____

10. What nerve provides motor innervation to the intrinsic muscles of the tongue?

_____

11. What nerve provides motor innervation to MOST of the extrinsic muscles of the tongue?

_____

12. Which of the extrinsic muscles of the tongue is NOT innervated like the others?

_____

a. What nerve provides motor innervation to this muscle?

_____

13. What nerve innervates mechanical and thermal receptors on the anterior 2/3 of the tongue?

_____

14. What nerve innervates mechanical and thermal receptors on the posterior 1/3 of the tongue?

_____

15. What nerve innervates taste buds on the anterior 2/3 of the tongue?

_____

16. What nerve innervates taste buds on the posterior 1/3 of the tongue?

_____

17. What cranial nerve provides motor innervation to the submandibular salivary glands?

_____

18. What cranial nerve provides motor innervation to the parotid salivary glands?

_____

19. What nerve provides sensory innervation to the gingiva of the maxillary teeth?

_____

20. What nerve provides sensory innervation to the gingiva of the mandibular teeth?

_____

21. What nerve provides sensory innervation to the mucosa overlying the hard palate?

_____

22. What nerve provides sensory innervation to the mucosa overlying the soft palate?

_____

**Application Exercises**

*A. Inspection and Palpation*

With the subject seated comfortably facing you:

1. Instruct the subject to open and close the mouth while you palpate the temporomandibular joints bilaterally.

   a. Are the two sides symmetrical to palpation? _____

      If not, describe what you feel:

      _____

2. Instruct the subject to clench the teeth together while you palpate the mandible immediately anterior and superior to the angle.

   a. What muscle do you feel contract beneath your fingers?

   _____

   b. What cranial nerve provides motor innervation to this muscle?

   _____

3. Instruct the subject to open the mouth widely. With the aid of a pen light inspect the position of the uvula.

   a. Is the uvula resting in the midline? _____

   If not, describe its position.

   _____

4. Inspect the lateral walls of the posterior part of the oropharynx.

   a. Are the palatine tonsils present in the tonsillar fossa?

   _____

   b. What cranial nerve provides sensory innervation to the posterior part of the oropharynx?

   _____

5. Inspect the tongue in the relaxed state lying on the floor of the mouth.

   a. Are the two sides visually symmetrical with regard to muscle bulk?

   _____

If not, describe the differences.

_____

*B. Movements*

1. With the tongue lying relaxed in the floor of the mouth, instruct the subject to say "AAHH."

   a. Describe the movement of the uvula.

   _____

   b. What muscle acts to move the uvula during phonation?

   _____

   c. What cranial nerve provides motor innervation to this muscle?

   _____

2. Instruct the subject to protrude the tongue.

   a. Does the tongue protrude in the midline?

   _____

   If not, describe the deviation.

   _____

   b. What muscle acts to protrude the tongue?

   _____

   c. What cranial nerve provides motor innervation to this muscle?

   _____

d. What cranial nerve provides general sensory (cutaneous) innervation to the anterior part of the tongue?

_____

e. What cranial nerve provides special sensory (taste) innervation to the anterior part of the tongue?

_____

# 11 Orbit and Eye

**Objectives**

1. Describe the normal relationship between the eye and the eyelids.

2. Demonstrate and describe in a living subject the action(s) of each of the extraocular muscles.

3. Describe and demonstrate in a living subject a method for evaluating the function of ocular motor function.

4. Describe the effect on the position of the resting eye resulting from destructive lesions affecting each of the extraocular nerves.

5. Describe the autonomic innervation of the iris.

6. Describe and demonstrate in a living subject a method for evaluating the pupillary light reflex and the accommodation reflex.

7. Describe the bony structure of the orbit and identify the contents.

**Anatomy Review Questions**

*Orbit*

1. What are the three openings located in the posterior part of the orbit?

   a. _____

   b. _____

   c. _____

2. What are the two main structures that pass through the optic canal?

   a. _____

   b. _____

3. What are the main structures that pass through the superior and inferior orbital fissures?

   a. _____ nerve

   b. _____ nerve

   c. _____ nerve

   d. _____ nerve

   e. _____ nerve

   f. _____ nerve

   g. _____ vein

   h. _____ vein

4. What are the main structures that pass through the common tendinous ring?

   a. _____ nerve

   b. _____ nerve

   c. _____ nerve

   d. _____ nerve

5. What is the name of the thin membrane that lines the surface of the cornea and deep surface of the upper and lower eye lids (palpebrae)?

   _____

6. What two muscles play a role in the elevation of the upper eyelid?

   a. _____

   b. _____

7. What are the two main types of glands in the upper eyelid?

   a. _____

   b. _____

8. Describe the location of the lacrimal gland in the orbit.

   _____

9. Where does the nasolacrimal duct drain?

   _____

10. What cranial nerve provides motor innervation to the lacrimal gland?

    _____

11. Which extraocular muscle does NOT originate from the common tendinous ring?

    _____

12. What nerve provides motor innervation to the levator palpebrae superioris muscle?

    _____

13. Where are the nerve cell bodies that provide motor innervation to Mueller's muscle?

    _____

*Eye*

1. What are the three layers of the eye? (List layers from superficial to deep.)

   a. _____

   b. _____

   c. _____

2. What nerve provides sensory innervation to the cornea?

   _____

3. What structure separates the anterior chamber from the posterior chamber of the eye?

   _____

4. What fluid is found in the anterior chamber of the eye?

   _____

5. What fluid is found in the posterior chamber of the eye?

   _____

6. What two muscles are located in the iris AND what division of the autonomic nervous system provides motor innervation to each?

   | | Muscle | Autonomic Division |
   |---|---|---|
   | a. | _____ | _____ |
   | b. | _____ | _____ |

7. What structure connects the lens to the ciliary muscle?

   _____

8. What is the effect of contraction of the ciliary muscle?

_____

9. Where are the nerve cell bodies that provide motor innervation to the ciliary muscle?

| Preganglionic cell | Postganglionic cell |
| --- | --- |
| _____ | _____ |

10. Where are the cell bodies that provide motor innervation to the pupillary constrictors?

| Preganglionic cell | Postganglionic cell |
| --- | --- |
| _____ | _____ |

11. Where are the cell bodies that provide motor innervation to the pupillary dilators?

| Preganglionic cell | Postganglionic cell |
| --- | --- |
| _____ | _____ |

12. What structure produces aqueous humor?

_____

13. Through what opening does aqueous humor normally pass to exit the eye?

_____

14. Where is this opening located?

_____

15. What is the optic disc?

_____

16. What is the physiologic cup?

_____

17. What is the macula lutea?

_____

18. What is the fovea centralis?

_____

19. What retinal structure is associated with the “blind spot” in the visual field?

_____

20. What are the two types of photoreceptor cells?

a. _____

b. _____

21. Which photoreceptor cell is heavily concentrated in the fovea centralis?

_____

22. What vessel is the origin of the central artery of the retina?

_____

23. The superior and inferior ophthalmic veins receive venous blood from intra-orbital structures. Blood in these vessels can drain out of the orbit by passing posteriorly, anteriorly or inferiorly, depending on intravenous pressure. What are the three (3) vascular structures that receive venous blood from the ophthalmic veins?

    a. _____ posteriorly

    b. _____ inferiorly

    c. _____ anteriorly

24. What are the three branches of the ophthalmic nerve in the orbit?

    a. _____

    b. _____

    c. _____

**Application Exercises**

*A. Inspection*

Instruct the subject to look straight ahead and focus on some non-moving object at a distance of 20 feet or more.

1. Inspect the sclera in both eyes.

    a. What color is the sclera?

    _____

    b. Are the scleral blood vessels engorged or dilated?

    _____

2. Inspect the iris in both eyes.

   a. What color is the iris?

   _____

   b. Are the irides free of defects?

   _____

   If not, describe the defect.

   _____

   c. Are the pupils round in both eyes?

   _____

   If not, describe their shape.

   _____

   d. Are the pupils stable in size or do they fluctuate in diameter?

   _____

3. What is the diameter of the RIGHT pupil?

   _____

4. What is the diameter of the LEFT pupil?

   _____

   a. What word is used to describe pupillary asymmetry of greater than 1 mm?

   _____

5. Using a pen light in a room in which the lights have been dimmed, quickly illuminate the RIGHT eye, taking care to avoid illuminating the left eye.

   a. What effect did you observe in the illuminated right eye?

   _____

Repeat the procedure described in number 5 above.

   b. What effect did you observe in the non-illuminated left eye?

   _____

   c. What reflex did you observe in the illuminated right eye?

   _____

   d. What reflex did you observe in the non-illuminated left eye?

   _____

6. Now, quickly illuminate the LEFT eye, taking care to avoid illuminating the right eye.

   a. What effect did you observe in the illuminated left eye?

   _____

Repeat the procedure described in number 6 above.

   b. What effect did you observe in the non-illuminated right eye?

   _____

7. Inspect the position of the eyes in the orbits.

   _____

a. Are the visual axes of both eyes parallel?

_____

If not, describe the malalignment.

_____

b. What term is used to refer to misalignment of the visual axes of the two eyes?

_____

c. Are the eyes held steady in the orbits?

_____

If not, describe the movements you see.

_____

d. What term is used to describe involuntary, oscillating movements of the eyes?

_____

*B. Movements*

1. Indicate the primary and secondary actions of each of the extraocular muscles (assume the eye to be in the position of primary gaze and that the muscle in question is the only muscle acting on the globe)

| Muscle | Primary Action | Secondary Actions |
|---|---|---|
| a. lateral rectus | _____ | |
| b. medial rectus | _____ | |
| c. superior rectus | _____ | _____ |
| d. inferior rectus | _____ | _____ |
| e. superior oblique | _____ | _____ |
| f. inferior oblique | _____ | _____ |

2. Indicate the cranial nerve that innervates each extraocular muscle.

| Muscle | Nerve |
|---|---|
| a. lateral rectus | _____ |
| b. medial rectus | _____ |
| c. superior rectus | _____ |
| d. inferior rectus | _____ |
| e. superior oblique | _____ |
| f. inferior oblique | _____ |

3. In the position of primary gaze in the normal situation, the eyes are directed straight ahead and the visual axes of the two eyes are parallel. Keep in mind that in this position all six, extraocular muscles in each eye are tonically active and that the position of the eye in the orbit reflects the combined, balanced actions of all six extraocular muscles contracting simultaneously. Any loss in the contractile force (weakness or paralysis) of a single extraocular muscle will result in movement of the eye about one or more axes produced by the relatively unopposed action of the remaining muscles. Indicate the effects on the eye resulting from paralysis of each of the extraocular muscles.

| Muscle | Primary Effect | Secondary Effect | |
|---|---|---|---|
| a. lateral rectus | _____ | | |
| b. medial rectus | _____ | | |
| c. superior rectus | _____ | _____ | _____ |
| d. inferior rectus | _____ | _____ | _____ |
| e. superior oblique | _____ | _____ | _____ |
| f. inferior oblique | _____ | _____ | _____ |

4. Extraocular muscle function can be evaluated by observing eye movement produced by each muscle when its action is exerted perpendicular to a single axis of rotation. Indicate the muscle being evaluated by each of the following movements.

a. abduction of the eye _____

b. elevation of the abducted eye _____

c. depression of the abducted eye _____

d. adduction of the eye _____

e. elevation of the adducted eye _____

f. depression of the adducted eye _____

5. Ocular malalignment (strabismus) can occur as a result of damage to the ocular motor nerves. Indicate the effects on the eye resulting from damage to each ocular motor nerve.

| | Nerve | Resulting Eye Position | | |
|---|---|---|---|---|
| a. | abducens nerve | _____ | | |
| b. | trochlear nerve | _____ | _____ | _____ |
| c. | oculomotor nerve | _____ | _____ | _____ |

6. Which cranial nerve, if damaged, will affect pupillary size?

_____

a. Will the pupil on the affected side be larger or smaller than the pupil on the uninvolved side?

_____

7. Which cranial nerve, if damaged, will result in ptosis?

_____

8. Which cranial nerve passes through the cavernous sinus, and as a result, can be damaged by intracavernous carotid artery aneurysms?

_____

9. Which cranial nerve emerges from the dorsal surface of the brainstem?

_____

# 12 Ear

**Objectives**

1. Name the different parts of the external ear.

2. Describe the features observable with the otoscope.

3. Describe the attachments and organization of the ossicles of the ear.

4. Identify the muscles that attach to the ossicles of the ear and indicate the nervous innervations of each.

**Anatomy Review Questions**

1. What two peripheral nerves provide sensory innervation to the auricle?

   a. _____

   b. _____

2. Which branchial arch is the origin of each of the following ossicles?

| Auditory Ossicle | Branchial Arch |
|---|---|
| Malleus | _____ |
| Incus | _____ |
| Stapes | _____ |

3. Which of the ossicles is attached to the internal surface of the tympanic membrane?

   _____

4. Which of the ossicles is attached to the oval window?

_____

5. What muscle attaches to the malleus?

_____

a. What cranial nerve innervates this muscle?

_____

6. What muscle attaches to the stapes?

_____

a. What cranial nerve innervates this muscle?

_____

7. What cranial nerve transmits auditory impulses to the brainstem?

_____

8. What foramen of the skull transmits the axons of the vestibulocochlear nerve?

_____

9. What vestibular system receptor structure is responsive to rotatory (angular) acceleration and deceleration of the head?

_____

10. What vestibular system receptor structure is responsive to linear acceleration and deceleration of the head?

_____

11. What fluid substance is found in the scala tympani?

_____

12. What fluid substance is found in the scala vestibuli?

_____

13. What fluid substance is found in the scala media?

_____

14. What fluid substance is found in the semicircular canals?

_____

15. Which vestibular receptor structures are associated with otoconia?

_____

16. Where are the cell bodies of the afferent nerve fibers of the cochlear nerve?

_____

17. Where are the cell bodies of the afferent nerve fibers of the vestibular nerve?

_____

## Application Exercises

*A. Inspection*

With the subject seated comfortably

1. Inspect the auricles, identifying the helix, antihelix, tragus, antitragus and concha.

    a. Are the right and left sides symmetrical?

    _____

    If not, describe the differences.

    _____

2. Inspect the external acoustic meatus.

3. Using an otoscope, carefully examine the tympanic membrane.

    a. What direction does the “cone of light” extend from the umbo?

    _____

    b. What cranial nerves provide sensory innervation to the external surface of the tympanic membrane?

    1) _____

    2) _____

# 13 Answer Key

## Spine and Back

*Anatomy Review Questions*

1. anterior longitudinal lig
2. posterior longitudinal lig
3. ligamentum flavum
4. intertransverse lig
5. Interspinous lig
6. ligamentum nuchae (supraspinous lig)
7. C6
8. C2
9. anterior
10. C8
11. a. iliocostalis
    b. longissimus
    c. spinalis
12. a. semispinalis
    b. multifidus
    c. rotatores
13. a. levator scapulae
    b. trapezius
14. a. oblique capitus superior
    b. oblique capitus inferior
    c. rectus capitus posterior major
    d. rectus capitus posterior minor
15. C1 and C2
16. nucleus pulposus
17. annulus fibrosus
18. vertebral artery
19. spinal epidural space
20. suboccipital nerve
21. vertebral artery
22. a. rhomboid major
    b. latissimus dorsi
    c. trapezius

23. a. latissimus dorsi
    b. external oblique
    c. iliac crest

*Application Exercises*

A. 1. a. there are curvatures in the sagittal plane
   b. 1) cervical
      2) lumbar
   c. lordosis
   d. 1) thoracic
      2) sacral
   e. kyphosis
   f. scoliosis
   2. a. vertebra prominens
   b. spinous process
   c. C7
   d. no – thick Supraspinous lig (ligamentum nuchae
   e. ligamentum nuchae
   3. superior and inferior nuchal lines of occipital bone
   4. yes
   5.
   6. a.
   b. L5
   7. a.
   8. a.
   b.
   9. a.
   b.
   10. a.
   11.

B. 1. anterior longitudinal ligament
   2. posterior longitudinal ligament
   3. ligamentum flavum
   4. intertransverse ligament
   5. interspinous ligament
   6. supraspinous
   7. a. iliocostalis
   b. longissimus
   c. spinalis

8. a. semispinalis
   b. multifidus
   c. rotatores
9. a. splenius capitis
   b. splenius cervicis
10. a. obliquus capitis superior
    b. obliquus capitis inferior
    c. rectus capitis posterior major
    d. rectus capitis posterior minor

## Shoulder Girdle and Upper Limb

*Anatomy Review Questions*

1. sternoclavicular joint
2. acromioclavicular joint
3. a. acromioclavicular lig
   b. coracoclavicular lig
4. coraco-acromial lig
5. annular lig
6. inferolateral or superomedial
7. palmaris longus
8. lateral border of first rib
9. inferior border of teres major
10. pectoralis minor
11. first part – superior thoracic
    second part – thoracoacromial and lateral thoracic
    third part – subscapular, art. humeral circumflex and post. humeral circumflex
12. dorsal scapular art.
13. a. radial art
    b. ulnar art
14. a. scaphoid (navicular)
    b. lunate
    c. triquetrum
    d. pisiform
15. a. trapezium (greater multangular)
    b. trapezoid (lesser multangular)
    c. capitate
    d. hamate
16. serratus anterior
17. intertubercular groove of humerus

18. C5 – T1
19. a. C5 and C6
    b. C7
    c. C8 and T1
20. posterior divisions
21. superior
22. posterior
23. posterior
24. posterior
25. medial
26. a. radial
    b. axillary
27. axillary
28. radial
29. ulnar
30. median
31. ulnar
32. Women – 15 (>15)
    Men – 12 (10 – 15)
33. pronator teres
34. flexor carpi ulnaris
35. a. brachialis
    b. brachioradialis
36. a. apical
    b. humeral
    c. central
    d. pectoral
    e. subscapular
37. a. extensor pollicis longus
    b. abductor pollicis longus and extensor pollicis brevis
38. radial

*Application Exercises*

A 1. a.
     b.
   2. a. gliding
      b. gliding
   3. a.
      b.
   4. a. acromion process
      b. T3

c. supraspinatus
d. infraspinatus

5. a. 5 CM
b. 2nd rib
c. 7th rib

6. a. pectoralis major
1) medial pectoral nerve
2) lateral pectoral nerve
b. latissimus dorsi and teres major
1) thoracodorsal and lower subscapular nerves

7. a. 1) biceps brachii and brachialis
2) brachialis
3) musculocutaneous nerve
b.

8. a. triceps brachii
1) radial nerve
b.

9. a. triceps brachii
b. ulnar nerve

10. a. 1) forearm pronation
2) wrist flexion
3) finger flexion

11. a. 1) forearm supination
2) wrist extension
3) finger extension

12. a. pronator teres
1) median nerve
b. brachioradialis
1) radial nerve
c. brachial artery
d. median cubital vein
e. pronator teres
f. flexorcarpiulnaris

13. a.
b.
c. radial nerve

14. a.
b.
c. 1) median nerve
2) ulnar nerve

15. a.

b.
c.
d. 1) extensor pollicis longus

16. a.
b.
c.
d. radial artery
e. ulnar artery
f. median nerve

17.

18. a.
b. 1) abductor pollicis brevis
2) flexor pollicis brevis
3) opponens pollicis
c. median nerve
d. 1) abductor digiti minimi
2) flexor digiti minimi
3) opponens digiti minimi
e. ulnar nerve

19. a. extensor pollicis longus
b. 1) abductor pollicis longus
2) extensor pollicis brevis
c. radial artery

20. a.
b. finger abduction
c. ulnar nerve
d. finger adduction
e. ulnar nerve

| | | | | |
|---|---|---|---|---|
| B | 1. | a. | trapezius | spinal accessory |
| | | b. | levator scapulae | dorsal scapular |
| | 2. | a. | rhomboid major | dorsal scapular |
| | | b. | rhomboid minor | spinal accessory |
| | | c. | trapezius | dorsal scapular |
| | 3. | a. | deltoid (ant) | axillary |
| | 4. | a. | deltoid | axillary |
| | | b. | supraspinatus | suprascapular |
| | 5. | a. | teres major | lower subscapular |
| | | b. | teres minor | axillary |
| | | c. | pectoralis major | pectoral (med. and lat.) |
| | | d. | latissimus dorsi | thoracodorsal |
| | 6. | a. | deltoid (post) | axillary |

| | | | |
|---|---|---|---|
| | b. | latissimus dorsi | thoracodorsal |
| 7. | a. | biceps brachii | musculocutaneous |
| | b. | brachialis | musculocutaneous |
| 8. | a. | brachioradialis | radial |
| | b. | brachialis | musculocutaneous |
| 9. | a | triceps brachii | radial |
| 10. | a. | pronator teres | median |
| | b. | pronator quadratus | median |
| 11. | a. | supinator | radial |
| | b. | biceps brachii | musculocutaneous |
| 12. | a. | extensor carpi radialis longus | radial |
| | b. | extensor carpi radialis brevis | radial |
| | c. | extensor carpi ulnaris | radial |
| 13. | a. | flexor carpi radialis | median |
| | b. | flexor carpi ulnaris | ulnar |
| 14. | a. | extensor carpi radialis longus | radial |
| | b. | extensor carpi radialis brevis | radial |
| | c. | flexor carpi radialis | median |
| 15. | a. | extensor carpi ulnaris | radial |
| | b. | flexor carpi ulnaris | ulnar |
| 16. | a. | abductor pollicis longus | radial |
| | b. | abductor pollicis brevis | median |
| 17. | a. | adductor pollicis | ulnar |
| 18. | a. | flexor pollicis longus | median |
| | b. | flexor pollicis brevis | median |
| 19. | a. | extensor pollicis longus | radial |
| | b. | extensor pollicis brevis | radial |
| | c. | abductor pollicis longus | radial |
| 20. | a. | opponens pollicis | median |
| | b. | opponens digiti minimi | ulnar |
| 21. | a. | lumbricales | median/ulnar |
| 22. | a. | extensor digitorum communis | radial |
| 23. | a. | dorsal interossei | ulnar |
| 24. | a. | palmar interossei | ulnar |
| 25. | a. | flexor digitorum superficialis | median |
| 26. | a. | flexor digitorum profundus | median/ulnar |
| 27. | a. | extensor digitorum communis | radial |

C 1.

2.

D 1.
2.
3.
4.
5. a. anterior scalene
b. middle scalene

## Hip Girdle and Lower Limb

*Anatomy Review Questions*

1. a. innominate (hip) bone
b. sacrum
2. a. ilium
b. ischium
c. pubis
3. a. iliofemoral
b. ischiofemoral
c. pubofemoral
d. hip extension
4. a. anterior superior iliac spine
b. pubic tubercle
5. ischial tuberosity
6. ischial spine
7. ant intercondylar tibia to post part, medial surface of lat femoral condyle
8. post intercondylar tibia to ant part, lateral surface of med femoral condyle
9. deltoid lig
10. femoral vein
11. popliteal vein
12. external iliac vein
13. a. femoral art.
b. femoral vein
14. loose connective tissue and lymphatics
15. inguinal lig.
16. adductor hiatus
17. a. anterior tibial art
b. posterior tibial art
18. anterior tibial art
19. L2 – S2
20. a. femoral nerve

b. obturator nerve
21. L4 – S2 (S3)
22. a. common fibular (common peroneal) nerve
b. tibial nerve
23. posterior tibial nerve
24. deep fibular (anterior tibial) nerve
25. Superficial fibular (superficial peroneal) nerve
26. deep fibular nerve
27. posterior tibial nerve
28. femoral nerve
29. saphenous nerve
30. a. inguinal lig
b. adductor longus
c. Sartorius
31. 126 degrees (range 115 – 140)
32. angle subtended by trans plane of fem condyles and axis of head/neck of femur
a. 7 degrees – males and 12 degrees – females
33. angle subtended by line of gravity and line between ASIS and center of patella
a. appox. 8 degrees
b. females
34. externally (laterally)
35. a. posterior
b. anterior
c. anterior
36. tight
37. tight
38. plantar calcaneonavicular lig

*Application Exercises*

A 1.
2. a. femoral artery
b. femoral vein
c. femoral nerve
d. 1) sartorius
2) adductor longus
3. a.
b. rectus femoris
c. anterior inferior iliac spine
4. a.
b. prevents lateral displacement of the patella during knee extension

5. a. apex of patella
   b. tibial tubercle
6. a. common fibular (peroneal) nerve
   b. soleus
7. a. 1) ankle dorsiflexion
      2) toe extension
   b. deep peroneal nerve
   c. anterior tibial artery
8. a. 1) peroneus longus
      2) peroneus brevis
9. a. plantar calcaneonavicular ligament
10. a.
    b.
11. a. anterior cruciate ligament
    b. anterior part of intercondylar eminence
    c. posteromedial surface of lateral femoral condyle
12. a. posterior cruciate ligament
    b. posterior part of intercondylar fossa
    c. anterolateral surface of medial femoral condyle
13. a. L4
14. a. sacrotuberous ligament
    b. 1) semitendinosus
       2) semimembranosus
       3) biceps femoris (long head)
       4) adductor magnus
15. a. superolateral (“upper outer quadrant”)
    b. to avoid injury to the sciatic nerve
16. a.
    b. knee flexion
17. a. biceps femoris
       1) a tibial nerve (long head)
          b common peroneal nerve (short head)
    b. 1) semitendinosus
       2) semimembranosus
       3) tibial nerve
    c. gastrocnemius
       1) tibial nerve
    d. popliteal artery
    e. tibial nerve
    f. popliteus
18. a.

| | | | | |
|---|---|---|---|---|
| | | b. | 1) plantar flexion | |
| | | | 2) toe flexion | |
| | | c. | 1) tibialis posterior | |
| | | | 2) flexor digitorum longus | |
| | | | 3) flexor hallucis longus | |
| | 19. | a. | | |
| | | b. | tibialis posterior | |
| B | 1. | a. | psoas major | lumbar nerves |
| | | b. | iliacus | femoral |
| | | c. | rectus femoris | femoral |
| | 2. | a. | quadriceps femoris | femoral |
| | 3. | a. | tibialis anterior | deep peroneal |
| | 4. | a. | gastrocnemius | tibial |
| | | b. | soleus | tibial |
| | | c. | tibialis posterior | tibial |
| | 5. | a. | extensor hallucis longus | deep peroneal |
| | | b. | extensor digitorum longus | deep peroneal |
| | | c. | extensor digitorum brevis | deep peroneal |
| | 6. | a. | flexor hallucis longus | tibial |
| | | b. | flexor digitorum longus | tibial |
| | 7. | a. | gluteus maximus | inferior gluteal |
| | 8. | a. | biceps femoris | tibial/common peroneal |
| | | b. | semitendinosus | tibial |
| | | c. | semimembranosus | tibial |
| | 9. | a. | adductor magnus | obturator/tibial |
| | | b. | adductor longus | obturator |
| | | c. | adductor brevis | obturator |
| | 10. | a. | gluteus medius | superior gluteal |
| | | b. | gluteus minimus | superior gluteal |
| C | 1. | | | |
| | 2. | | | |
| D | 1. | | | |
| | 2. | | | |
| | 3. | | | |
| | 4. | | | |

**Thorax**

*Anatomy Review Questions*

1. a. manubrium

b. body
c. xiphoid process

2. a. 1st thoracic vertebra
b. 1st rib
c. manubrium (sternal notch)

3. a. 12th thoracic vertebra
b. 12th and 11th ribs
c. costal cartilages
d. xiphoid process

4. anterior-inferior or superior-posterior
5. posterior-inferior or superior-anterior
6. a. 1st rib
b. 1st rib
c. 2nd rib
7. a. elevates the upper ribs
b. depresses the lower ribs
8. a. external intercostal membrane
b. internal intercostal membrane
9. on the inferior margin of the rib above
10. a. vein
b. artery
c. nerve
11. internal thoracic artery
12. internal thoracic vein
13. subclavian artery (1st part)
14. subclavian artery (1st part)
15. a. superior epigastric artery
b. musculophrenic artery
16. brachiocephalic veins
17. superior vena cava
18. azygos vein or left renal vein
19. azygos vein
20. anterior scalene

*Application Exercises*

A 1. a.
2. a. T2
3. a. T4
b. 2nd rib
4. a. T9

b. ribs 1-7
c. ribs 8-10

5. a. ribs 11 and 12
6. a. posteriorly
   b. kyphosis
7. a.
   b.
   c.
   d.
   e. scoliosis
8.
9.
10. a. rib 2
    b. rib 7

B 1.
2. anteriorly and inferiorly
3. posteriorly and inferiorly
4. T4

## Lungs and Pleura

*Anatomy Review Questions*

1. a. visceral pleura
   b. parietal pleura
2. a. costal
   b. mediastinal
   c. diaphragmatic
   d. cervical
3. a. 1) apical
      1) posterior
      1) anterior
      2) medial
      2) lateral
      3) superior
      3) anterior basal
      3) lateral basal
      3) posterior basal
      3) medial basal
   b. 1) apico-posterior

1) anterior
1) superior (lingual)
1) inferior (lingual)
2) superior
2) anterior basal
2) lateral basal
2) posterior basal
2) medial basal

4. left lung
5. right lung
6. a. sternal angle
   b. T4 – T5 intervertebral disc
7. right
8. a. trapezius
   b. rhomboid major (or medial border of inferior angle of the scapula)
   c. latissimus dorsi
9. 6th
10. a. T8
    b. T10
    c. T12
11. inferior vena cava
12. a. esophagus
    b. anterior and posterior vagal trunks
13. a. aorta
    b. azygos vein
    c. thoracic duct
14. phrenic nerve
15. C3, C4, C5

*Application Exercises*

A 1. a. expiration
   b. 12-18
2.
3.

B 1.
2. a. 8th rib
   b. 10th rib
   c. 12th rib
3. 6th costal cartilage
4. 4th costal cartilage

5.
6. a. 6th rib
   b. 8th rib
   c. 10th rib
7. 6th costal cartilage
8. 4th costal cartilage
9.
10. a. T3
    b. 5th
    c. 6th
11.
12. a. 5th rib
    b. 4th

## Heart

*Anatomy Review Questions*

1. a. sternal angle
   b. T4 – T5 intervertebral disc
2. a. xiphisternal joint
   b. T9 vertebra
3. a. fibrous layer
   b. serous layer
4. a. parietal layer
   b. visceral layer
5. visceral pericardium
6. a. parietal layer of serous pericardium
   b. visceral layer of serous pericardium
7. a. pulmonary valve
   b. aortic valve
   c. mitral valve
   d. tricuspid valve
8. a. right atrium
   b. left atrium
9. from pulmonary artery to aorta
10. right atrium
11. right atrium
12. a. right ventricle
    b. left ventricle

13. chordae tendinae
14. a. anterior interventricular
    b. circumflex
15. a. right marginal
    b. posterior interventricular
16. a. great cardiac vein
    b. middle cardiac vein
    c. small cardiac vein
    d. left posterior interventricular vein
    e. left marginal vein
17. anterior cardiac veins
18. a. dorsal motor nucleus of X
        1) acetylcholine
    b. cardiac plexus
        1) acetyl choline
19. a. intermediolateral nucleus
        1) acetylcholine
    b. superior, middle and inferior cervical ganglia
        1) norepinephrine
20. a. brachiocephalic trunk
    b. left common carotid artery
    c. left subclavian vein
21. right pulmonary vein

*Application Exercises*

A 1. a.
     b.
     c.
     d.
   2. a.
     b.
     c.
     d.
   3. a.
     b.
     c.
     d.

B 1. a.
   2. a.

b.

C 1. a. S2
b. S1
c. S2
d. S1

2. systole

## Abdomen

*Anatomy Review Questions*

1. a. superficial fatty layer (Camper's fascia)
   b. deep membranous layer (Scarpa's layer)
2. transversalis fascia
3. a. internal oblique
   b. transversus abdominus
4. a. aponeurosis of the external oblique and anterior ½ of internal oblique
   b. aponeurosis of the transversus abdominus and posterior ½ of internal oblique
5. a. aponeurosis of all three abdominal muscles
   b. transversalis fascia
6. a. inferior epigastric artery
   b. deep circumflex iliac artery
7. a. superficial epigastric artery
   b. superficial circumflex iliac artery
8. a. uracus
   b. umbilical artery
   c. inferior epigastric vessels
9. transversalis fascia
10. external oblique aponeurosis
11. internal oblique
12. a. external oblique aponeurosis
    b. transversalis fascia
    c. peritoneum
13. cardia
14. pyloric antrum
15. a. left gastric artery
    b. splenic artery
    c. hepatic (common) artery
16. a. right gastric artery

b. left gastric artery

17. a. right gastroepiploic (gastro-omental) artery
    b. left gastroepiploic (gasttro-omental) artery
18. splenic artery
19. proper hepatic artery
20. a. superior mesenteric vein
    b. splenic vein
21. splenic vein
22. a. superior
    b. descending
    c. inferior (horizontal)
    d. ascending
23. a. bile duct
    b. pancreatic duct
24. descending
25. sphincter of the major duodenal papilla
26. dilated duct receiving bile and pancreatic duct – drains into descending duodenum
27. ascending
28. inferior (horizontal)
29. cecum
30. a. cecum
    b. ascending
    c. transverse (proximal half)
31. a. descending
    b. sigmoid
32. a. cystic duct
    b. common hepatic duct
33. a. hepatic artery
    b. portal vein
    c. bile duct
34. a. L4
    b. L1
    c. L5
    d. L3
    e. L2
    f. L2
35. right
36. left
37. cisterna chili
38. junction left internal jugular and left subclavian (“venous angle”)
39. ½ the distance from the ASIS to the umbilicus

*Application Exercises*

A
1. a.
   b.
   c.
2. a.
   b.
3. a.
   b. above

B
1.
2.
3.
4.
5. a. approximately 3 cm below the right costal margin in the midaxillary line
6.
7. a. L4
8. a. 1) liver (right lobe)
      2) gall bladder
      3) duodenum (parts 1 and 3)
      4) pancreas (head)
      5) right kidney
      6) hepatic flexure
      7) right adrenal gland
      8) superior part of ascending colon
      9) transverse colon – right half
      10) pylorus
   b. 1) stomach
      2) spleen
      3) liver (left lobe)
      4) pancreas (body and tail)
      5) left kidney
      6) left adrenal gland
      7) splenic flexure
      8) descending colon (upper part)
      9) jejunum
   c. 1) appendix
      2) cecum
      3) ileum (most)
      4) right ovary
      5) right ureter

6) ascending colon (inferior part)
7) right uterine tube
8) urinary bladder (enlarged)
9) right spermatic cord
10) uterus (enlarged)

d. 1) left ovary
2) left ureter
3) descending colon (inferior part)
4) sigmoid colon
5) left uterine tube
6) left spermatic cord
7) uterus (enlarged)
8) urinary bladder (enlarged)

9.

10. a. L3

b. 1) right hypochondriac
2) epigastric
3) left hypochondriac

11. a. L5

b. 1) right lumbar
2) umbilical
3) left lumbar

c. 1) right inguinal (iliac)
2) hypogastric (pubic)
3) left inguinal (iliac)

12.

13. T10

14. anteriorly and inferiorly

15. posteriorly and inferiorly

C 1. a. yes

b.

c. long, prolonged “gurgles” of hyperperistalsis “stomach growling”

2. a. midline just below the xiphoid process

b. along the semilunar line at the level of the 10th costal cartilage

c. along the semilunar line at the level of the iliac crest

## Head and Face

*Anatomy Review Questions*

1. a. occipital

b. parietal
2. a. frontal
b. parietal
3. a. zygomatic bone
b. temporal bone
4. a. frontal
b. parietal
c. temporal
d. sphenoid
5. approximately 18 months
6. falx cerebri
7. tentorium cerebelli
8. a. skin
b. dense connective tissue
c. epicranial aponeurosis
d. loose connective tissue
e. periosteum (pericranuim)
9. a. facial artery
b. lingual artery
c. superficial temporal artery
d. superior thyroid artery
e. maxillary artery
10. facial artery
11. a. superior sagittal sinus
b. inferior sagittal sinus
c. superior petrosal sinus
d. cavernous sinus
12. a. inferior petrosal sinus
b. sigmoid sinus
13. vertebral artery
14. middle meningeal artery
15. a. right anterior cerebral artery
b. left anterior cerebral artery
16. a. middle cerebral artery
b. posterior cerebral artery
17. a. ophthalmic artery
b. anterior choroidal artery
c. posterior communicating artery
d. middle cerebral artery
e. anterior cerebral artery
18. facial nerve

19. a. temporalis
    b. masseter
    c. lateral pterygoid
    d. medial pterygoid
20. a. ophthalmic nerve
    b. maxillary nerve
    c. mandibular nerve
21. glossopharyngeal nerve
    a. otic ganglion
22. facial nerve
    a. submandibular ganglion
23. facial nerve
    a. pterygopalatine ganglion
24. facial nerve
25. trigeminal nerve
26. trigeminal nerve
    a. ophthalmic nerve
        1) superior orbital fissure
    b. maxillary nerve
        1) foramen rotundum
    c. mandibular nerve
        1) foramen ovale
27. jugular foramen
28. stylopharyngeus
29. a. taste from posterior 1/3 of tongue
    b. arterial pressure measured at the carotid sinus
30. jugular foramen
31. a. laryngeal muscles
    b. upper third of the pharyngeal constrictors
32. slowing of heart rate
33. increased motility
34. a. blood gas monitoring at carotid body
    b. taste perception from the epiglottis
35. a. foramen magnum
    b. jugular foramen
36. a sternocleidomastoid
    b. trapezius
37. hypoglossal canal
38. genioglossus
39. facial nerve
40. internal auditory (acoustic) meatus

41. stylomastoid foramen
42. a. temporal
    b. zygomatic
    c. buccal
    d. marginal mandibular
    e. cervical
43. a. greater superficial petrosal nerve
    b. deep petrosal nerve
44. facial nerve (nervus intermedius)
45. facial nerve (nervus intermedius)
46. glossopharyngeal nerve

## Application Exercises

A
1. a.
   b.
2. a. confluence of sinuses
3. a.
   b.
   c.
   d.
   e.
4. a.
5. a.
6. a.
   b. levator palpebrae superioris
      1) oculomotor nerve
   c.
   d.
   e.
   f.
   g. 1) orbicularis oculi
      2) facial nerve
7. a.
8. a.
9. a.
10. a.
11. a.
12. a.
13. a.

B
1. a. frontalis

b. facial
c.

2. a. orbicularis oculi
b. facial
c.
d. supraduction of the eye in conjunction with forceful eye closure

3. a. risorius
b. facial nerve
c.

4. a. orbicularis oris
b. facial nerve

5.

6. a masseter
b.. temporalis
c. trigeminal nerve

C 1. a. external carotid artery

2.

3. a. external carotid artery

**Neck**

*Anatomy Review Questions*

1. a. investing fascia
b. pretracheal fascia
c. prevertebral fascia
d. carotid sheath

2. a. sternocleidomastoid
b. trapezius

3. a. infrahyoid muscles
b. thyroid gland
c. trachea
d. esophagus

4. a. carotid arteries
b. internal jugular vein
c. vagus nerve

5. a. midline of neck
b. anterior border of sternocleidomastoid
c. inferior border of mandible

6. a. anterior border of sternocleidomastoid

b. posterior belly of digastric
c. superior belly of omohyoid

7. a. posterior belly of digastric
b. anterior belly of digastric
c. inferior border of mandible

8. a. anterior belly of digastric
b. hyoid bone
c. midline beneath mandible

9. a. superior belly of omohyoid
b. anterior border of sternocleidomastoid
c. sternohyoid

10. a. anterior border of trapezius
b. posterior border of sternocleidomastoid
c. superior border of clavicle

11. a. sternohyoid
b. thyrohyoid
c. sternothyroid
d. omohyoid

12. a. digastric
b. stylohyoid
c. mylohyoid
d. geniohyoid

13. posterior cricoarytenoid
14. internal laryngeal nerve (branch of superior laryngeal)
15. a. lateral cricoarytenoid
b. transverse arytenoid
16. internal laryngeal nerve
17. cricothyroid
18. external laryngeal nerve
19. internal laryngeal nerve
20. a. anterior scalene
b. middle scalene
21. posterior
22. anterior
23. lateral border of first rib
24. a. vertebral artery
b. thyrocervical trunk (artery)
c. internal thoracic artery
d. costocervical trunk (artery)
25. external carotid artery
26. common carotid artery

27. a. superficial temporal vein
    b. maxillary vein
28. a. retromandibular vein
    b. posterior auricular vein
29. a. internal jugular vein
    b. subclavian vein
30. C3, C4, C5
31. C1, C2, C3
32. C4
33. C1 - C4
34. C5 and C6
35. C7, C8, (T1)

*Application Exercises*

A 1. a.
   b.
   2. a. 1) midline of neck
      2) anterior border of sternocleidomastoid
      3) inferior border of mandible
   3.
   4. a. C3
   5. a. C5
   6. a. up
   7. a. C6
   8. a. 1) sternothyroid
      2) thyrohyoid
      3) sternohyoid
      4) omohyoid
   9. a.
   10. a. C7
   11. a. 1) anterior border of trapezius
      2) posterior border of sternocleidomastoid
      3) superior border of clavicle
      b.
      c. 1) splenius capitis
      2) levator scapulae
      3) posterior scalene
      4) middle scalene
      d. rotation to the contralateral side
   12. a.

B 1. a. C4
2. a. vagus nerve
b. internal jugular vein
3. a. carotid tubercle
b.

## Mouth and Pharynx

*Anatomy Review Questions*

1. a. masseter
b. temporalis
2. mylohyoid
3. palatoglossus
a. vagus nerve
4. palatopharyngeus
a. vagus nerve
5. palatoglossus
6. palatopharyngeus
7. glossopharyngeal nerve
8. a. levator veli palatine
b. tensor veli palatine
9. vagus nerve
10. hypoglossal nerve
11. hypoglossal nerve
12. palatoglossus
a. vagus nerve
13. trigeminal nerve
14. glossopharyngeal nerve
15. glossopharyngeal nerve
16. glossopharyngeal nerve
17. facial nerve
18. glossopharyngeal nerve
19. maxillary nerve (trigeminal V2)
20. mandibular nerve (trigeminal V3)
21. greater palatine nerve
22. lesser palatine nerve

*Application Exercises*

A 1. a.

2. a. masseter
   b. trigeminal
3. a.
4. a.
   b. glossopharyngeal
5. a.

B 1. a.
   b. levator veli palatini
   c. vagus
2. a.
   b. genioglossus
   c. hypoglossal
   d. trigeminal
   e. facial

## Eye

*Anatomy Review Questions*

Orbit

1. a. optic canal
   b. superior orbital fissure
   c. inferior orbital fissure
2. a. optic nerve
   b. ophthalmic artery
3. a. frontal nerve
   b. lacrimal nerve
   c. nasociliary nerve
   d. oculomotor nerve
   e. trochlear nerve
   f. abducens nerve
   g. superior ophthalmic vein
   h. inferior ophthalmic vein
4. a. oculomotor nerve (superior branch)
   b. oculomotor nerve (inferior branch)
   c. nasociliary nerve
   d. abducens nerve
5. conjunctiva
6. a. levator palpebrae superioris
   b. superior tarsal muscle (Mueller's muscle)

7. a. tarsal glands
   b. ciliary glands
8. anterior in the supero-lateral margin
9. below the inferior nasal concha
10. facial nerve
11. inferior oblique
12. oculomotor
13. superior cervical ganglion

Eye

1. a. sclera (fibrous)
   b. choroid (vascular)
   c. retina (neural)
2. long ciliary > nasociliary > trigeminal
3. iris
4. aqueous humor
5. aqueous humor
6. a. pupillary constrictor — parasympathetic
   b. pupillary dilator — sympathetic
7. suspensory ligament of the lens (zonular fibers of Zinn)
8. accommodation of the lens
9. Edinger-Westphal nucleus — ciliary ganglion
10. Edinger-Westphal nucleus — ciliary ganglion
11. intermediolateral nucleus — superior cervical ganglion
12. ciliary body
13. canal of Schlemm (scleral venous sinus)
14. lateral margin of the anterior chamber
15. point of exit of retinal ganglion cell axons from the retina
16. center of the optic disc
17. retinal region of high visual acuity
18. center of macula lutea – area of highest visual acuity
19. optic disc
20. a. rods
    b. cones
21. cone
22. ophthalmic artery
23. a. cavernous sinus (posteriorly)
    b. pterygoid sinus (inferiorly)
    c. angular vein (anteriorly)
24. a. frontal nerve
    b. nasociliary nerve

c. lacrimal nerve

*Application Exercises*

A 1. a. white
b.
2. a.
b.
c.
d.
3.
4. a. anisocoria
5. a. pupillary constriction
b. pupillary constriction
c. direct light reflex
d. indirect (consensual) light reflex
6. a. pupillary constriction
b. pupillary constriction
7. a.
b. heterotropia (tropia) or strabismus
c.
d. nystagmus

B 1. a. abduction
b. adduction
c. supraduction intorsion adduction
d. subduction extorsion adduction
e. intorsion subduction abduction
f. extorsion supraduction abduction
2. a. abducens
b. oculomotor
c. oculomotor
d. oculomotor
e. trochlear
f. oculomotor
3. a. adducted
b. abducted
c. subducted extorted abducted
d. supraducted intorted abducted
e. extorted supraducted adducted
f. intorted subducted adducted
4. a. lateral rectus

b. superior rectus
c. inferior rectus
d. medial rectus
e. inferior oblique
f. superior oblique

5. a. adducted
   b. extorted supraducted adducted
   c. subducted abducted intorted
6. oculomotor
   a. larger
7. oculomotor
8. abducens
9. trochlear

## Ear

*Anatomy Review Questions*

1. a. great auricular nerve
   b. auriculotemporal nerve
2. malleus 1st arch
   incus 2nd arch
   stapes 3rd arch
3. malleus
4. stapes
5. tensor tympani
   a. trigeminal
6. stapedius
   a. facial
7. cochlear (auditory)
8. internal auditory meatus
9. semicircular canals
10. utricle and saccule (otolithic organs)
11. perilymph
12. perilymph
13. endolymph
14. endolymph
15. utricle and saccule (otolithic organs)
16. spiral ganglion
17. vestibular (Scarpa's) ganglion

*Application Exercises*

A 1. a.
2.
3. a. anteriorly and inferiorly
b. 1) trigeminal
2) vagus

# About the Authors

**Michael F. Nolan** is professor of Basic Science Education at the Virginia Tech Carilion School of Medicine in Roanoke. He received his Physical Therapy training at Marquette University and his PhD in Human Anatomy from the Medical College of Wisconsin. Nolan spent the first 34 years of his career teaching gross anatomy and neuroanatomy to medical students and resident physicians at the University of South Florida. He has received more than 20 awards for excellence in teaching including the Master Teacher Award in 2014 from the International Association of Medical Science Educators and the John M. Thompson Outstanding Teacher Award in Neurosurgery in 2006. He has published over 40 peer-reviewed articles and book chapters as well as four textbooks in human gross anatomy and neuroanatomy.

**John P. McNamara** is the Director of Anatomy and Assistant Professor of Basic Science Education at the Virginia Tech Carilion School of Medicine in Roanoke. His doctoral training is in chiropractic from Life University (Marietta, GA) with undergraduate (Lock Haven University of Pennsylvania) and graduate (Shippensburg University of Pennsylvania) degrees. He is also ABD from Virginia Tech in Educational Leadership and Policy Studies. For nearly the past 30 years, McNamara has maintained a private practice in Salem, VA, and taught full-time anatomy and physiology, gross anatomy, neuroanatomy, and pathophysiology at the College of Health Sciences (Jefferson College) in Roanoke. From 2013 to 2017 he taught the gross anatomy course for the Doctor of Physical Therapy program at Radford University in Roanoke. He is licensed to practice as a Doctor of Chiropractic in both Virginia and Pennsylvania, and he is certified as an Emergency Medical Technician in Virginia.