N3: ANATOMY AND PHYSIOLOGY
1st Semester, Academic Year 2024-2025

LECTURE: MUSCULAR SYSTEM
STUDY GUIDE

I. Learning Outcomes:
At the end of the session, you should be able to:

1. Name and explain the differences among the three types of muscular tissue.
2. Compare the functions and special properties of the three types of muscular tissue.
3. Describe the microscopic anatomy and functions of a skeletal muscle fiber.
4. Outline and describe the steps involved the contraction and relaxation of muscle fibers.
5. Describe how muscle action potentials arise at the neuromuscular junction.
6. Describe aerobic and anaerobic metabolism in muscle cells.
7. Describe the structure and function of a motor unit and explain the phases of a twitch contraction.
8. Describe the relationship between bones and skeletal muscles and how they interact to produce body movements.
9. Describe the characteristics used in naming skeletal muscles.
10. Describe the development of muscles
11. Identify the common sites used in intramuscular injections.
12. Identify principal skeletal muscles and describe their movements, roles and names:

II. Activities

ACTIVITY	DESCRIPTION
1. Lecture	Powerpoint slides and video presentation will be provided and you will be able to access these after the lecture.
2. Supplementary Activities*	
3. Post-lecture quiz*	10-point quiz

* These activities will not be part of your grade but you have to complete them on time to be eligible for exemption from taking the final examination.

III. References:
Tortora, & Derrickson. (2012). Chapter 10: Muscular tissue. In *Principles of anatomy and physiology* (13th ed.).
Tortora, & Derrickson. (2012). Chapter 11: The Muscular System. In *Principles of anatomy and physiology* (13th ed.).

IV. General Instructions
- Read Chapters 10 and 11 of the reference book. Use the study guide provided.
- I encourage that you make your own notes as you go through your readings and the videos in this guide. I also encourage handwritten notes as this will further facilitate memorization.
- Other ways to facilitate learning and memorization include:
    - Repetition- after making your notes, try verbally repeating them to someone else or you can even talk to yourself.
    - Try making flash cards or small notes on index cards.

- Test yourselves. You can answer the mock quizzes provided in the reference book or have someone else test you.
- Always get enough sleep. If you are feeling tired during long study hours, try taking short naps.
- Reading and studying for long periods of time can be very taxing. Take short breaks- walk, stretch, exercise, listen to music.

- After reading, you can watch the slide presentation provided for this module. The link is posted separately.

- There are other links to videos which are optional viewing.

- There are activities provided in this guide to further facilitate learning. There will be a forum assigned to each of the activities. This is where you will make your submissions.

- After the activities, there will be a 10-point quiz. The activities and the quiz results will not form part of your grades but you have to submit these on time to be able to be eligible for exemption from taking the final examination.

V. Topic and Study Guide

A. Muscular tissue

1. Overview of muscular tissue
   a. Types of muscular tissue
   b. Functions of muscular tissue
   c. Properties of muscular tissue

2. Skeletal muscle tissue
   a. Organization of skeletal muscle and its connective tissue coverings.
   b. Microscopic anatomy of a skeletal muscle fiber and organization of skeletal muscle
      - Define and describe a muscle fiber, myofibril, and sarcomere
      - List the major proteins in a sarcomere that are involved with contraction

   You can view this video to further illustrate (optional):

   https://www.youtube.com/watch?v=qMdfZL9XtTs
   Skeletal Muscle Levels of Organization + Filament Basics
   by Sciebert Science

   c. Contraction and relaxation of skeletal muscle fibers- the sliding filament mechanism
   d. Contraction and relaxation of skeletal muscle fibers- excitation-contraction coupling
      - Explain the sliding filament process of muscle contraction
      - Describe the excitation-contraction coupling process

   You can view this video to further illustrate (optional):

   https://www.youtube.com/watch?v=4oOspJKunCQ
   Sliding Filament Model and Excitation Contraction Coupling
   By Sciebert Science

e. Neuromuscular junction and how action potentials are generated

- Name and describe the components of the neuromuscular junction and explain how action potentials are generated.

You can view this video to further illustrate (optional):

https://www.youtube.com/watch?v=zbo0i1r1pXA
Neuromuscular Junction, Animation
By ©Alila Medical Media

f. Muscle metabolism

- Describe the three mechanisms for generating energy for muscle metabolism
  1) Use of creatine phosphate
  2) Aerobic metabolism in muscle cells
  3) Anaerobic metabolism in muscle cells

g. Motor unit

- Describe the structure and function of a motor unit

h. Mechanism of muscle contraction

- Define motor unit recruitment.
- Explain the phases of a twitch contraction.
- Describe how frequency of stimulation affects muscle tension- wave summation, incomplete and complete tetanus
- Describe how muscle tone is produced.
- Distinguish between isotonic and isometric contractions.

You can view these very short videos to further illustrate (optional):

https://www.youtube.com/watch?v=v5Nm_LaAQVo
Twitch, Summation and Tetanus of Skeletal Muscle
By Scientist Cindy

https://www.youtube.com/watch?v=1E3MLkvnCME
Recruitment of Small and Large Motor Units
By Scientist Cindy

https://www.youtube.com/watch?v=DkCcn9iBczw
Isotonic, Isometric, Eccentric and Concentric Muscle Contractions
By Scientist Cindy

i. Types of skeletal muscle fiber tissues

- Compare the structure and function of the three types of skeletal muscle fibers.

j. Regeneration of muscular tissue

- Read Section 10.10 of the reference book and be able to describe how muscles regenerate

k. Development of muscle

- Read Section 10.11 of the reference book.
- Except for muscles such as those of the iris of the eyes and the arrector pili muscles attached to hairs, all muscles of the body are derived from mesoderm.

B. Muscular System

1. Muscle attachment sites- origin and insertion
    - Origin- usually this is the attachment of a muscle's tendon to the stationary bone
    - Insertion- the attachment of the muscle's other tendon to the movable bone is called the insertion

2. How skeletal muscles produce movements
    - Define the prime mover, antagonist, synergist, and fixator in a muscle group and how they work together to produce movement.

3. Principal skeletal muscles:
   Go through Exhibits 11A to 11T (chapter 11) in your reference book to know the principal skeletal muscles. You don't have to memorize all of them; just go through them so you are familiar with terms used in different groupings of muscles.

   In particular, familiarize yourself with the muscles in Table 11.2 and Figure 11.3 as these are the more common superficial skeletal muscles of the body.

    - Muscles of the Head That Produce Facial Expressions
    - Muscles of the Head That Move the Eyeballs (Extrinsic Eye Muscles) and Upper Eyelids
    - Muscles That Move the Mandible and Assist in Mastication and Speech
    - Muscles of the Head That Move the Tongue and Assist in Mastication and Speech
    - Muscles of the Anterior Neck That Assist in Deglutition and Speech
    - Muscles of the Neck That Move the Head
    - Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column
    - Muscles of the Abdomen That Protect Abdominal Viscera and Move the Vertebral Column
    - Muscles of the Thorax That Assist in Breathing
    - Muscles of the Pelvic Floor That Support the Pelvic Viscera and Function as Sphincters
    - Muscles of the Perineum
    - Muscles of the Thorax That Move the Pectoral Girdle
    - Muscles of the Thorax and Shoulder That Move the Humerus
    - Muscles of the Arm That Move the Radius and Ulna
    - Muscles of the Forearm That Move the Wrist, Hand, Thumb, and Digits
    - Intrinsic Muscles of the Hand
    - Muscles of the Neck and Back That Move the Vertebral Column
    - Muscles of the Gluteal Region That Move the Femur
    - Muscles of the Thigh That Move the Femur and Tibia and Fibula
    - Muscles of the Leg That Move the Foot and Toes
    - Intrinsic Muscles of the Foot That Move the Toes

   You can view this video to help you (optional):

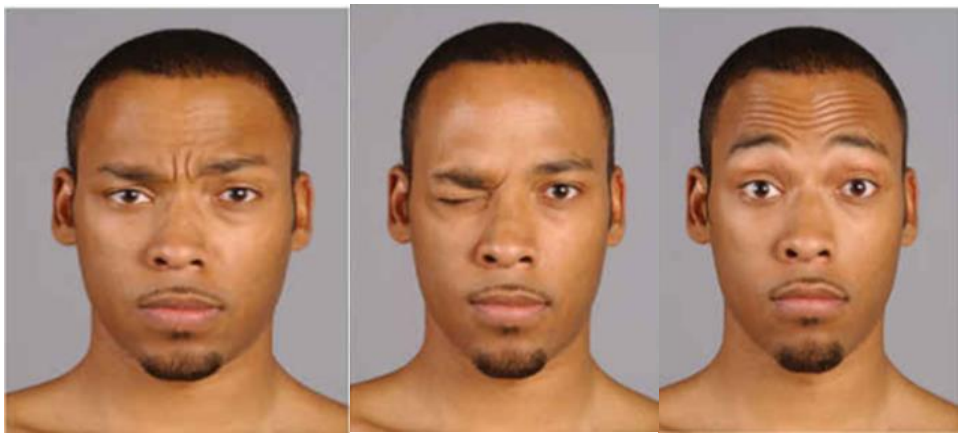
https://www.youtube.com/watch?v=21bgO104QVU
The Muscular System
By Professor Dave explains

V. Activities
Read the questions in each activity and post your answers in the forum assigned for each activity:

A. ACTIVITY 1
Name the muscle that may cause the following facial expression and write down its origin, insertion and action.

1. 2. 3.

4. 5. 6.



B. ACTIVITY 2
Name at least three muscles that contracts during the following activities and name its action and innervation:

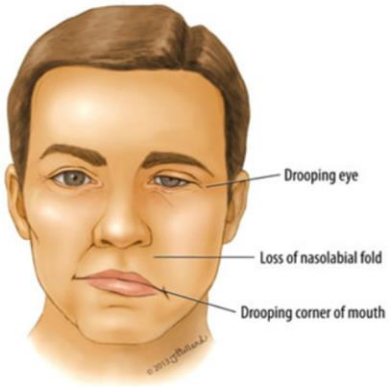
1. Throwing a baseball overhead
2. Kicking a ball
3. Doing sit-ups
4. Walking
5. Breathing

C. ACTIVITY 3

1) It is immunization day at the health center. The first patient is a 2-month old well female infant who is scheduled for the following vaccinations: pneumococcal conjugate vaccine (PCV), pentavalent vaccine (Penta) and oral polio vaccine. PCV and Penta are given via intramuscular route. Where are the sites of injection? What muscle is targeted in the injection? Write down its origin, insertion and action. How do you locate this area?

2) The baby's 65-year-old grandfather also came to the center because influenza vaccine is being offered to senior citizens. The flu vaccine is given intramuscularly. Which muscle is the preferred site for IM injection in this case? Write down its origin, insertion and action. How do you locate this area?

D. ACTIVITY 4



This is patient AM, 28-year-old male who came in the ER because of drooping of his left face. He said he woke up and he could not move his left face.

He has no other muscle weakness. He is conscious and coherent although he had a little difficulty speaking because the left side of his lips drooped. He had normal blood pressure and he had no other co-morbidities. He was diagnosed to have Bell's palsy. Name 5 muscles which are affected and list its actions.