

N3: ANATOMY AND PHYSIOLOGY
1st Semester, Academic Year 2023-2024

LECTURE: RESPIRATORY SYSTEM
STUDY GUIDE

Introduction

As you have learned in previous lessons, our cells need oxygen in cellular respiration in order to produce ATP for energy. A byproduct of this cellular respiration is carbon dioxide which can be harmful to the cells. To maintain homeostasis, the respiratory system takes up oxygen from atmospheric air and expels potentially harmful carbon dioxide. The cardiovascular system, through the heart and the blood vessels, transports blood containing the gases between the lungs and body cells. These two systems are intricately connect and hence will be discussed one after the other.

I. Learning Outcomes:

At the end of the session, you should be able to:

1. Describe the gross and microscopic anatomy and functions of the different structures of the respiratory system.
2. Describe the events that cause inhalation and exhalation (pulmonary ventilation)
3. Describe the factors that affect pulmonary ventilation (breathing)
4. Describe the process of oxygen and carbon dioxide exchange in external and internal respiration
5. Describe the factors that affect the rate and ease of pulmonary and systemic gas exchange
6. Describe how oxygen and carbon dioxide are transported in the blood
7. Describe the factors that affect the affinity of oxygen to hemoglobin
8. Describe how respiration is controlled and what regulates the rate and depth of respiration

II. Activities

ACTIVITY	DESCRIPTION
1. Asynchronous lecture	Powerpoint slides and video presentation
2. Supplementary Activities	Submission in discussion forum in VLE
3. Post-lecture quiz	10-point quiz

III. References:

Tortora, & Derrickson. (2012). Chapter 23: The Respiratory System. In *Principles of anatomy and physiology* (13th ed.) or its equivalent in other editions.

IV. General Instructions

- Read Chapters 23 of the reference book. Use the study guide provided.
- 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 which will form part of your grades.

- From 11am to 12 nn, we will have an online meeting where you can bring up your questions. The link will be posted separately.

V. Topic and Study Guide

A. Respiratory system anatomy

1. Structural anatomy

- Upper respiratory tract system- nose, nasal cavity, pharynx
- Lower respiratory tract system- larynx, trachea, bronchi and lungs

2. Functional division

- Conducting zone- mainly for conduction of air from outside to inside the body; their function is to filter, warm, and moisten air
 - composed of the nose, nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, and terminal bronchioles
- Respiratory zone- where gas exchange occurs
 - composed of the respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli

3. Structures

Enumerate the structures of the respiratory tract, its significant gross and microscopic anatomical features and its relevant functions.

a. Nose

- What are the borders of the nasal cavity?
- What are the openings present in the nasal cavity?
- What are gross and microscopic features of the tissue in the nasal cavity and how do these contribute to the functions of the nasal cavity?

b. Pharynx

- What are the borders of the pharynx?
- What are the divisions of the pharynx, its epithelial linings and the overall functions of these divisions?

c. Larynx

- What are the borders of the larynx? What are the gross anatomical landmarks of the larynx?
- What cartilages make up the larynx?
- What is the histology of the areas in the larynx?
- What are the important functions of the larynx?

d. Trachea

- What are the borders of the trachea?
- What is the composition of the tracheal wall?
- What contributes to the patency of the trachea?

e. Bronchial tree (bronchi and bronchioles)

- Describe the branching of the tracheobronchial tree/ bronchial tree.
- Describe differences in the right and left bronchi and its significance.
- Describe the structural changes (changes in cartilaginous, muscular and mucous membrane components) as the branching of the bronchial tree becomes more extensive. Describe the significance of the structural changes.
- Describe autonomic effects on the bronchial tree.

f. Lungs

- Describe the gross anatomy of the lungs including the pleural membranes and pleural cavity.

- Describe the microscopic features of the lungs
 - Describe the blood supply to the lungs
- g. Microscopic structures in the respiratory system
- Enumerate and describe the microscopic airways in a lobule including respiratory bronchioles and alveoli and their linings
 - Describe their functions

*Take note of the following tables and figures in your textbook (from 13th edition):

- Figure 23.7 Branching of the airways from the trachea: the bronchial tree (p. 928)
- Figure 23.10 Microscopic anatomy of the lobule of the lungs (p.932)
- Figure 23.11 Structural components of an alveolus (p. 933)
- Table 23.1 Summary of the respiratory system (p. 935)

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

Respiratory system by Professor Dave explains

<https://www.youtube.com/watch?v=ZB7uA5o0mS4>

B. Pulmonary ventilation

1. Differences among the terms pulmonary ventilation, external (pulmonary) respiration and internal (tissue) respiration
2. Describe Boyle's law and how it applies to breathing
3. Describe the differences in the process of inhalation and exhalation
4. Describe the factors that affect breathing:
 - a. Air pressure differences (difference between atmospheric pressure and alveolar pressure)
 - b. Surface tension of the alveolar fluid
 - c. Lung compliance
 - d. Airway resistance
5. Identify different modified respiratory movements. See Table 23.2 (p. 941) - Modified respiratory movements in your textbook.

C. Lung volumes and capacities

1. Explain the difference between tidal volume, inspiratory reserve volume, expiratory reserve volume, and residual volume.
2. Differentiate between inspiratory capacity, functional residual capacity, vital capacity, and total lung capacity.
3. Refer to Figure 23.16 Spirogram of lung volumes and capacities (p. 942) of your textbook

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

Lung Volumes and Capacities | Spirogram | Spirometry by Byte size med

<https://www.youtube.com/watch?v=BP-uPD92DMk>

D. Exchange of Oxygen and Carbon Dioxide

1. Explain how Dalton's and Henry's laws relate to the exchange of oxygen and carbon dioxide in the respiratory system
2. Describe the process of oxygen and carbon dioxide exchange in external and internal respiration
3. Describe the factors that affect the rate and ease of pulmonary and systemic gas exchange:
 - a. Partial pressure difference between gases
 - b. Surface area available for exchange

- c. Diffusion distance
- d. Molecular weight and solubility of the gases

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

Respiration gas exchange by Armando Hasudungan
<https://www.youtube.com/watch?v=qDrV33rZlyA>

E. Transport of oxygen and carbon dioxide

1. Describe how the blood transports oxygen.
 - a. Dissolved in blood plasma
 - b. Majority are bound to hemoglobin

2. Describe the factors that affect the binding and dissociation of oxygen to hemoglobin and how these factors affect the oxygen-hemoglobin dissociation curve
 - a. Partial pressure of oxygen
 - b. pH or acidity
 - c. Partial pressure of carbon dioxide
 - d. Temperature
 - e. BPG (2,3-bisphosphoglycerate)

2. Describe how carbon dioxide is transported in the body.
 - a. Dissolved in plasma
 - b. Combines with other amino acids to form carbamino compounds → carbaminohemoglobin
 - c. Transported as bicarbonate ions in the RBCs

* Refer to Figure 23.23 Summary of chemical reactions that occur during gas exchange.

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

<https://www.youtube.com/watch?v=xEHGIRpGyh4>
How Red Blood Cell Carry Oxygen and Carbon Dioxide by Alila Medical media

F. Control of respiration

1. Describe the respiratory center in the brain, its three areas and its functions
2. List the factors that can alter the rate and depth of breathing:
 - a. Cortical influences
 - b. Chemoreceptors (central and peripheral)
 - c. Proprioceptors
 - d. Inflation reflex
 - e. Other influences: limbic system, temperature, pain, stretching of anal sphincter muscle, airway irritation, blood pressure

Refer to Table 23.3 Summary of Stimuli That Affect Ventilation Rate and Depth (p. 956) of your textbook.

G. Development of the respiratory system

1. Describe the development of the respiratory system.

VI. Activities

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

A. ACTIVITY

Briefly explain the main cause or mechanism of increase in respiratory rate or depth and/or respiratory difficulties in the following cases: (one to two sentences only)

1. Initiation of exercise
2. Moderate exercise
3. Asthma attack
4. Abrupt ascent into high altitudes
5. Pneumonia
6. Paralysis of phrenic nerve
7. Severe tuberculosis with resulting lung scar tissue
8. Severe anemia
9. advanced COPD (chronic obstructive pulmonary disease)
10. Advanced pregnancy