**Chapter 1: Anatomy and Physiology of the Respiratory and Laryngeal Systems**

**Chapter Overview**

Voice production depends on the integrated coordination of the respiratory, phonatory, and resonatory systems. Voice is also influenced by the digestive and endocrine systems, and voice production is controlled and regulated by the central and peripheral nervous systems. This chapter focuses on the respiratory, laryngeal, and nervous system involvement in voice production. The chapter begins with a discussion of the structure of the lower respiratory system and the mechanics of breathing, followed by a description of lung volumes and capacities. Differences between breathing for life and breathing for speech are identified, and nervous system control of respiration is described. Discussion then turns to the laryngeal system with a review of laryngeal structure and function, the expanded myoelastic-aerodynamic theory of phonation, and mechanisms involved in changing pitch and loudness levels. The major functional components of the central and peripheral nervous systems subserving voice production are presented followed by a description of inflammation and wound healing in the vocal folds. The chapter concludes with a discussion of the three primary vocal registers used in speech. The purpose of the chapter is to assure that the professional knows and understands the essential anatomic and physiologic components of the voice system so that disorders of the voice are not limited to perceptual and acoustic characteristics. In order to understand how the voice is disordered it is essential to understand how the voice is produced.

**Objectives**

1. The student will learn and understand the structure and function of the respiratory system (skeletal, physiologic, and neurologic) as it relates to the voice.
2. The student will master lung volumes and capacities relative to resting expiration.
3. The student will learn to clinically differentiate respiration for speech from biological respiration.
4. The student will learn the anatomy and physiology of the larynx related to speech sound production.
5. The student will study the theories of phonation and vocal fold mechanics.
6. The student will learn about pitch and loudness control.
7. The student will master the three components involved in wound healing in the vocal folds.
8. The student will learn about vocal registers and the relationship to the perception of the voice.

**Key Terms**

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| **Term** | **Chapter Page** |
| Tracheobranchial Tree | 3-6 |
| Pleural Linkage | 6-7 |
| Diaphragm and Intercostals | 6-8 |
| Accessory Muscles | 9-10 |
| Lung Volumes and Capacities | 10-12 |
| Laryngeal Cartilages | 17-22 |
| Laryngeal Joints | 22-24 |
| Membranes and Folds | 24-27 |
| Vocal Fold Layers | 29-34 |
| Cover Body Model | 34-36 |
| Extrinsic Muscles | 38-41 |
| Intrinsic Muscles | 42-47 |
| Phonation Theory | 47-48 |
| Vocal Fold Cycles | 49-50 |
| Phonation Threshold Pressure | 51-52 |
| Pitch and Loudness | 53-54 |
| Nervous System | 55-62 |
| Wound Healing | 63-66 |
| Registers | 66-68 |

**Chapter 2: Lifespan Changes in the Respiratory and Phonatory Systems**

**Chapter Overview**

Efficient speech breathing is a process that develops over time in conjunction with anatomical and physiological changes in the young child’s respiratory system. Changes in the respiratory system continue throughout the lifespan, including changes in lung volumes and capacities in young, middle-aged, and older adults. There are many differences between the structure of the larynx at the time of birth and the more mature organ in terms of position of the larynx in the neck, shape and size of laryngeal cartilages, vocal fold length, and histological composition of the vocal folds. Newborns and infants, with their tiny vocal folds, have an average F0 ranging from 400–600 Hz. Infant cries provide information regarding nervous system status and physiological function. Maturation of the nervous system allows the infant a greater degree of laryngeal muscle control as well as greater control over subglottal air pressure. Infant crying is important not only for survival but also as the beginning of human vocal communication. During puberty laryngeal growth occurs in both sexes, but it is particularly pronounced in males due to the release of androgens. During this time of growth and change the vocal ligament continues the process of differentiating into separate layers with different cellular compositions. In addition, the larynx descends to the level of C6 or C7 resulting in a longer vocal tract, which changes the resonating characteristics as well as the pitch of the voice. After puberty the voice and F0 stabilize. The larynx attains its adult size, shape, and structure, including differentiated vocal ligaments. The adult female voice is often characterized by a slight degree of breathiness resulting from a posterior glottal gap during vocal production. Postpubertal girls and women may be affected vocally by fluctuating hormone levels during the menstrual cycle. Vocal aging is influenced by many factors, including the structural and physiological changes that occur in the larynx, the individual’s overall state of health, the acoustic characteristics that are a consequence of the structural and physiological changes, the way in which the voice is perceived by listeners, the influence of gender (i.e., menopause in women), and related or unrelated vocal disorders. The term *presbyphonia* has been coined to characterize the aging of the laryngeal mechanism. The variable of age must be taken into consideration when assessing vocal function. Otherwise, the effects of normal aging on laryngeal performance could be mistaken for those of laryngeal pathology.

**Objectives**

1. Students will learn how the respiratory systems of infants, children, and adults are relatively the same and different.

2. Students will learn how the laryngeal structures of infants, children, and adults are different.

3. Students will learn the impact of puberty on phonation for females and males.

4. Students will learn how the voice changes as a result of hormonal changes.

5. Students will learn how the voice changes in response to the aging process.

**Key Terms**

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| **Term** | **Chapter Page** |
| Fetal Development | 671-73 |
| Stages of Speech Breathing | 73-74 |
| Immature & Mature Larynx | 76-79 |
| Infant Vocalizations | 79-80 |
| Childhood F0 and Changes | 81 |
| Pubescent Voice | 81-82 |
| Adult Voice | 83-84 |
| Parameters of Aging Voice | 84 |
| Aging Structural Changes | 86-87 |
| Acoustics of Aging Voice | 87-89 |
| Perception of Aging Voice | 90 |
| Health and Aging Voice | 90-91 |