

## Lungs and Respiratory System

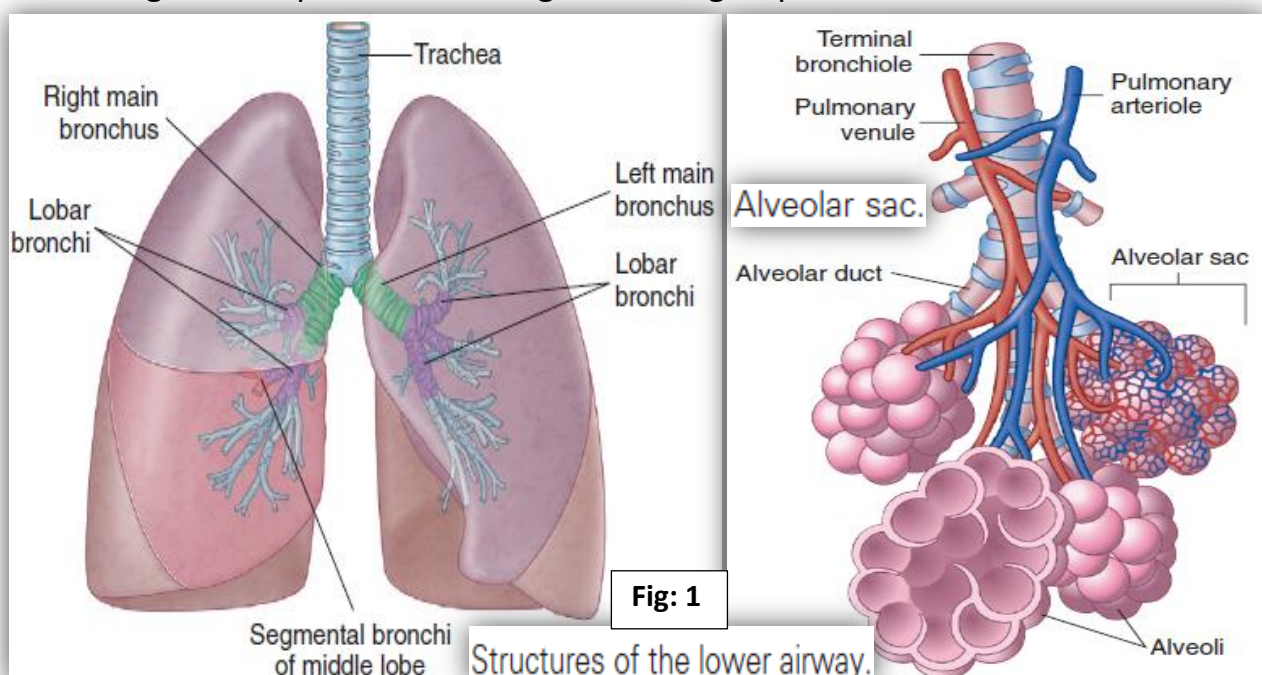
The primary purpose of the respiratory system is to supply oxygen to cells and remove carbon dioxide. This purpose is accomplished using the processes of ventilation and diffusion. **Ventilation** is the process of moving gases in and out of the lungs by inspiration and expiration. **Diffusion** is the process by which oxygen and carbon dioxide move from areas of high concentration to areas of lower concentration.

### Structures of the Respiratory System

The respiratory system (Fig. 13.1) begins at the nose and continues as a series of airways or passages extending to the alveoli where gas exchange takes place. The **nasal, oropharynx, and conducting airways** (trachea & bronchi) are considered dead space because no exchange of gases occurs there.

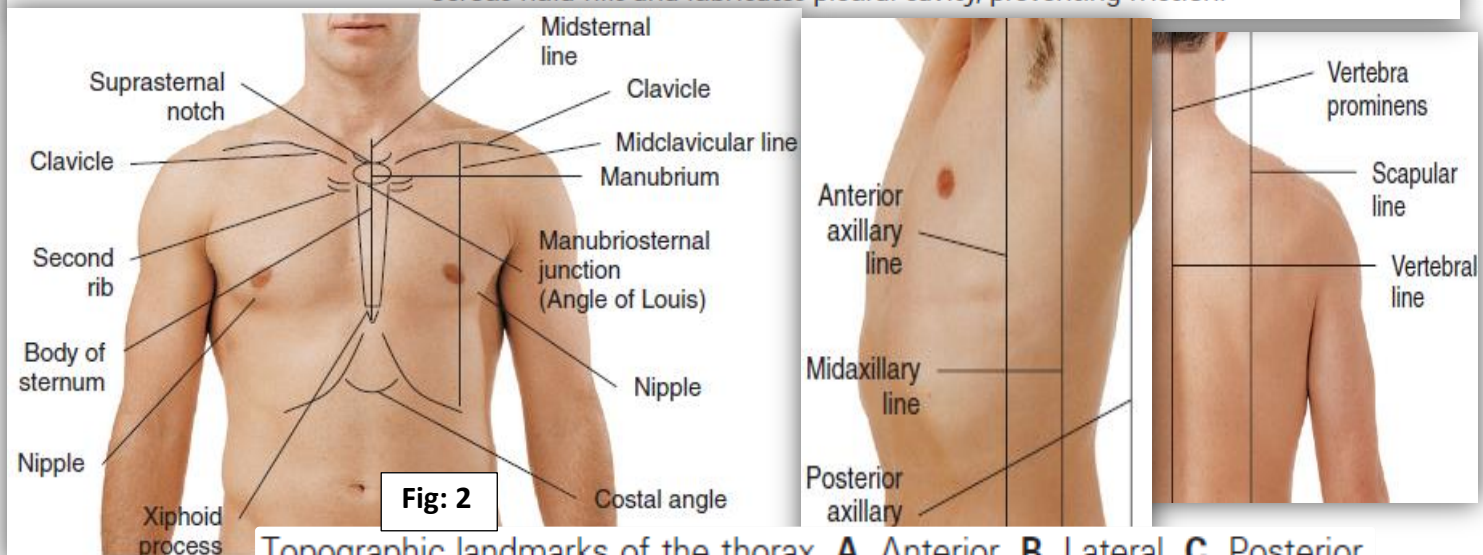
The **bronchioles** are transitional airways where some gas exchange occurs. The alveolar ducts, sacs, and alveolus are the functional units of the lung in which exchange of gases occurs with the pulmonary capillary bed. The primary muscle of respiration is the **diaphragm**; the secondary muscles are called the **accessory muscles**. The negative lung pressure that is needed for breathing is maintained by the **pleura**.

**Accessory muscles** include the sternocleidomastoid, anterior serrati, scalene, trapezius, intercostal, and rhomboid muscles. They come into play during strenuous physical activity (such as jogging) or when the body has intrapulmonary resistance to air movement. The accessory muscles enhance ventilation by increasing chest expansion and lung size during inspiration.



## Structures and Functions of the Respiratory System

STRUCTURE	DESCRIPTION/PRIMARY FUNCTION
Nasal Cavity	<ul style="list-style-type: none"> <li>Warms, filters, and moistens air.</li> </ul>
Pharynx	<ul style="list-style-type: none"> <li>Musculomembranous tube that acts as a passage between nose and larynx for air and between mouth and esophagus for food.</li> </ul>
Nasopharynx	<ul style="list-style-type: none"> <li>Consists of three parts: nasopharynx, oropharynx, and laryngopharynx.</li> <li>Passage for air behind nasal cavities.</li> <li>Adenoids or pharyngeal tonsils located on posterior wall are lymphoid tissue and have a protective function.</li> <li>Eustachian tubes extend from middle ears and open into nasopharynx to equalize atmospheric pressure.</li> </ul>
Oropharynx	<ul style="list-style-type: none"> <li>Passage for both air and food, located behind mouth.</li> </ul>
Laryngopharynx	<ul style="list-style-type: none"> <li>Palatine tonsils are on lateral wall of oropharynx.</li> <li>Most inferior portion of pharynx.</li> </ul>
Larynx	<ul style="list-style-type: none"> <li>Opens anteriorly into larynx and posteriorly into esophagus.</li> <li>Passage between pharynx and trachea.</li> <li>Contains vocal cords to produce sound.</li> </ul>
Single Cartilages	<ul style="list-style-type: none"> <li>Cartilages that support larynx.</li> </ul>
<ul style="list-style-type: none"> <li>Thyroid</li> <li>Epiglottis</li> <li>Cricoid</li> </ul>	<ul style="list-style-type: none"> <li>Prevents food from entering trachea.</li> </ul>
Paired Cartilages	<ul style="list-style-type: none"> <li>Support and affect vocal cords.</li> </ul>
Trachea	<ul style="list-style-type: none"> <li>Conducting airway between the larynx and the bronchi, about 10 to 12 cm long.</li> <li>Divides into two primary bronchi midthorax at the carina.</li> </ul>
Bronchi	<ul style="list-style-type: none"> <li>Conducting airways to hilum of each lung.</li> <li>Each primary bronchus branches into secondary (lobar) and tertiary (segmental) bronchi.</li> </ul>
Bronchioles	<ul style="list-style-type: none"> <li>Smaller transitional airways to alveoli.</li> <li>Consist of bronchioles (&gt;1 mm in diameter), terminal bronchioles (&gt;0.5 mm), and even smaller respiratory bronchioles, in which some gas exchange occurs.</li> </ul>
Alveolar Ducts, Sacs	<ul style="list-style-type: none"> <li>Functional units of lung.</li> <li>Each lung has more than 350 million alveoli, in which exchange of gases between alveoli and pulmonary capillary bed occurs.</li> </ul>
Pleura Serous	<ul style="list-style-type: none"> <li>Protective linings of lungs that maintain negative pressure and aid in mechanics of breathing.</li> <li>Consists of parietal pleura and visceral pleura.</li> </ul>
Parietal Pleura	<ul style="list-style-type: none"> <li>Line thoracic wall and superior portion of diaphragm.</li> </ul>
Visceral Pleura	<ul style="list-style-type: none"> <li>Extension of parietal pleura that covers lung.</li> <li>Serous fluid fills and lubricates pleural cavity, preventing friction.</li> </ul>



**TOPOGRAPHIC MARKERS:** Surface landmarks are helpful in locating underlying structures and describing the exact location of physical findings (Fig. 2).

**Anterior Chest Wall**

- Nipples
- Suprasternal notch: The depression at the anterior aspect of the neck, just above the manubrium
- Manubriosternal junction (angle of Louis): The junction between the manubrium and sternum; useful for rib identification
- Midsternal line: Imaginary vertical line through the middle of the sternum
- Costal angle: Intersection of the costal margins, usually no more than 90 degrees. The costal margins are the medial margins formed by the false ribs, from the eighth to the tenth ribs (see Fig. 2)
- Clavicles: Bones extending out both sides of the manubrium to the shoulder; they cover the first ribs
- Midclavicular lines: Imaginary vertical lines on the right and left sides of the chest that are “drawn” through the clavicle midpoints parallel to the midsternal line.

**Lateral Chest Wall**

- Anterior axillary lines: Imaginary vertical lines on the right and left sides of the chest “drawn” from anterior axillary folds through the anterolateral chest, parallel to the midsternal line
- Posterior axillary lines: Imaginary vertical lines on the right and left sides of the chest “drawn” from the posterior axillary folds along the posterolateral thoracic wall with abducted lateral arm
- Midaxillary lines: Imaginary vertical lines on the right and left sides of the chest “drawn” from axillary apices; midway between and parallel to the anterior and posterior axillary lines (see Fig. 2)

**Posterior Chest Wall:**

- Vertebra prominens: Spinous process of C7; visible and palpable with the head bent forward
- Vertebral line: Imaginary vertical line “drawn” along the posterior vertebral spinous processes

## Health Assessment

## Lab 4: Thorax Assessment

- Scapular lines: Imaginary vertical lines on the right and left sides of the chest “drawn” parallel to the midspinal line; they pass through inferior angles of the scapulae in the upright patient with arms at sides (see Fig 2).

### GENERAL HEALTH HISTORY

- 1- **Present Health Status:**
- 2- **Past Health History:** (medical & surgical)
- 3- **Family History:**
- 4- **Personal and Psychosocial History:**

### Physical examination (Chest and Lungs)

The respiratory system affects every other system, so look for changes from head to toe in each system that might signal a respiratory problem.

**Inspect breathing pattern:** Notice the respiratory rate. In the adult passive breathing should occur at a rate of 12 to 20 breaths /min.

**Eupnea** refers to normal rate, depth, and rhythm of respirations. Rate varies with age. Depth/tidal volume for an adult are 300 to 500 mL/min, considered moderate. Rhythm should be regular, with signs every 15 minutes at rest. Respiration should be quiet and relaxed unless the patient is involved in vigorous activity.

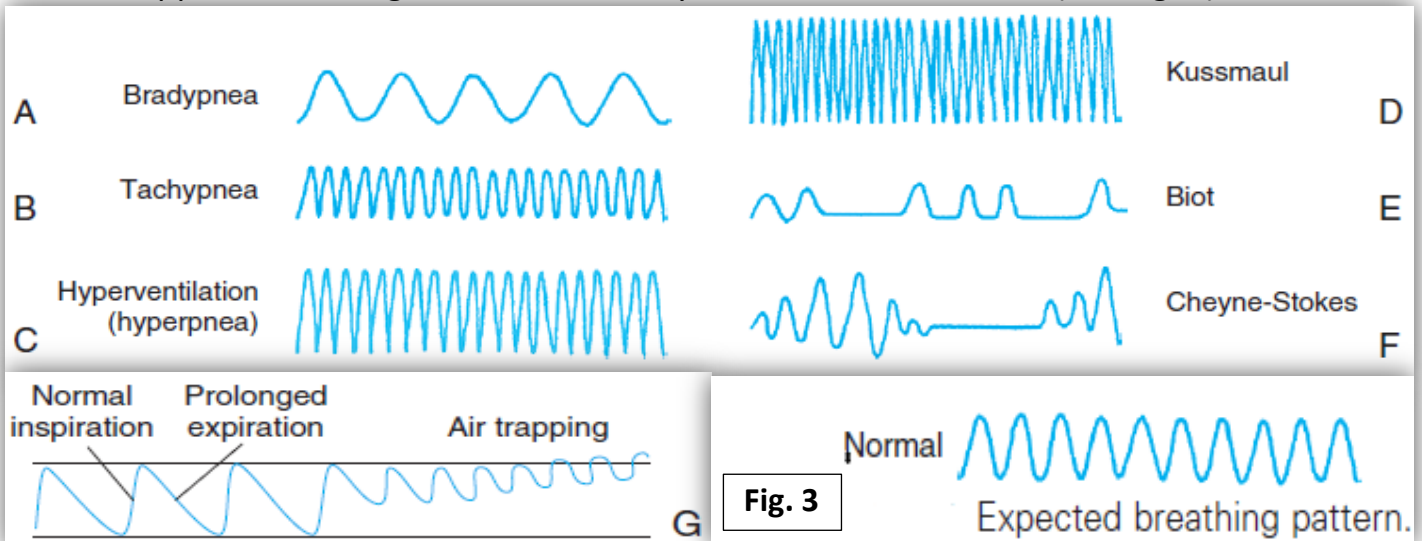
- A. Bradypnea:** (decreased rate less than 11 breaths/ min. The rate and depth remain smooth and even) Results from excessive sedation, hyper-apnea, compromised neurological control of breathing, or metabolic alkalosis.
- B. Tachypnea:** (increased rate greater than 20 breaths/min. The rate and depth remain smooth and even). Can be caused by activity, hypoxia, metabolic acidosis, anxiety, fear, pain, compromised neurological control of breathing, sepsis, fever, or increased metabolism.
- C. Hyperventilation:** is characterized by increased rate greater than 20 breaths/ min and depth of respiration.
- D. Kussmaul:** (When hyperventilation occurs with ketoacidosis, it is very deep and laborious) Rapid, deep respiration associated with metabolic acidosis (body's attempt to blow off CO<sub>2</sub>), seen in diabetic ketoacidosis or lactic acidosis.
- E. Cheyne-Stokes:** Progressively increasing rapid, deep respiration that peaks and then gradually ceases, followed by a period of apnea, after which the pattern recurs. Can be drug overdose, related to heart or renal failure, a sign of brain damage or impending death, or normal in frail elderly people during sleep.
- F. Biot's:** Ataxic breathing pattern that is irregular pattern in rate and depth and alternates with irregular periods of apnea. Seen in respiratory depression, damage to medullary respiratory centers, or head injury.


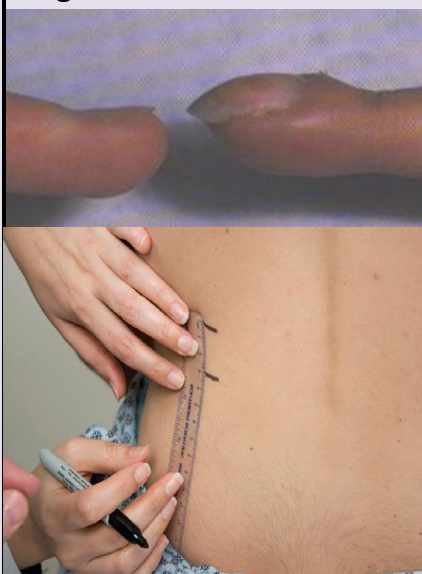


## Health Assessment

## Lab 4: Thorax Assessment

**G. Air trapping:** is an abnormal respiratory pattern frequently seen in patients with chronic obstructive pulmonary disease. It is characterized by rapid inspirations with prolonged, forced expirations. Air is not fully exhaled; thus it becomes trapped in the lungs, which eventually leads to a barrel chest. (see Fig. 3)



Physical Exam	Normal finding	Abnormal finding
<p><b>Chest and Lungs</b></p> <p><b>INSPECT</b> the front and back of chest</p> <ul style="list-style-type: none"> <li>Size/shape/symmetry</li> <li>skin characteristics</li> <li>thoracic Landmarks</li> <li><b>OBSERVE</b> respirations for rate, breathing pattern, and chest expansion</li> <li>chest movement with breathing (Symmetry).</li> </ul>	<ul style="list-style-type: none"> <li>General appearance, posture, and breathing effort, patient's nails, skin, and lips.</li> <li>Relaxed The posture should be upright. Breathing should be quiet, effortless, and at a rate appropriate for the patient's age</li> <li>Nail beds should be pink, with an angle of 160 degrees at the nail bed.</li> </ul>  	<ul style="list-style-type: none"> <li>Indications of respiratory distress include an appearance of apprehension with restlessness, nasal flaring, supraclavicular or intercostal retractions, and bulging with expiration and use of accessory muscles.</li> <li><b>Tripod position</b> (leaning forward with the arms braced against the knees, a chair, or a bed that enhances accessory muscle use) also suggests respiratory distress.</li> <li><b>Cyanosis</b> or pallor of the nails, skin, or lips may be a sign of inadequate oxygenation of tissues caused by an underlying respiratory or cardiovascular condition. Clubbing of the nails is associated with chronic hypoxia</li> <li>Abnormal breathing patterns are described in (Fig. 3).</li> <li><b>Chest retraction:</b> appears when intercostal muscles are drawn inward between the ribs and indicates airway obstruction that may occur during an asthma attack or pneumonia.</li> </ul>

## Health Assessment

## Lab 4: Thorax Assessment

### Palpate thoracic muscles and skeleton

- **Symmetry/condition**  
Size/ shape/symmetry

#### 1-Thoracic expansion:

Assessing for posterior thoracic expansion.

**A:** With thumbs together on either side of patient spinal process, extend fingers and ask patient to take deep breaths through the mouth.

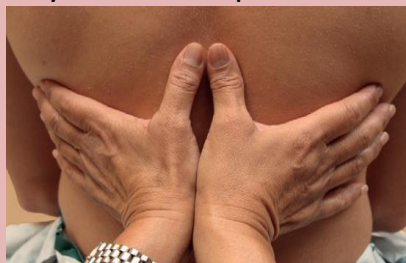
**B:** As patient takes deep breaths, observe lateral movement of both thumbs.

#### 2-Tactile fremitus

Ask patient to recite numbers or words "ninety-nine" while systematically palpating chest you can feel this vibration using palmar surfaces of fingers or ulnar aspect of clenched fist, using firm, light touch. Assess each area, front to back, side to side, lung apices. Compare sides.

- Bilateral symmetry. Some elasticity of rib cage, but sternum and xiphoid relatively inflexible and thoracic spine rigid.

- Symmetric expansion



- Great variability; generally, fremitus is more intense with males (lower-pitched voice).



- Pulsations, tenderness, bulges, depressions, unusual movement, unusual positions.

- Asymmetric expansion.

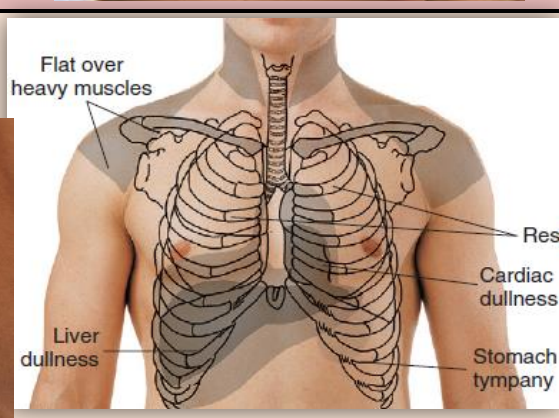
- Decreased or increased fremitus.



### percussion on chest

Indirect percussion  
Compare all areas bilaterally, following a sequence, for common tones, intensity, pitch, duration, diaphragmatic excursion, lung border, and quality.

- Resonance sound over lung (for characteristic of lung sound see table 3)



### AUSCULTATE the thorax for vocal sounds:

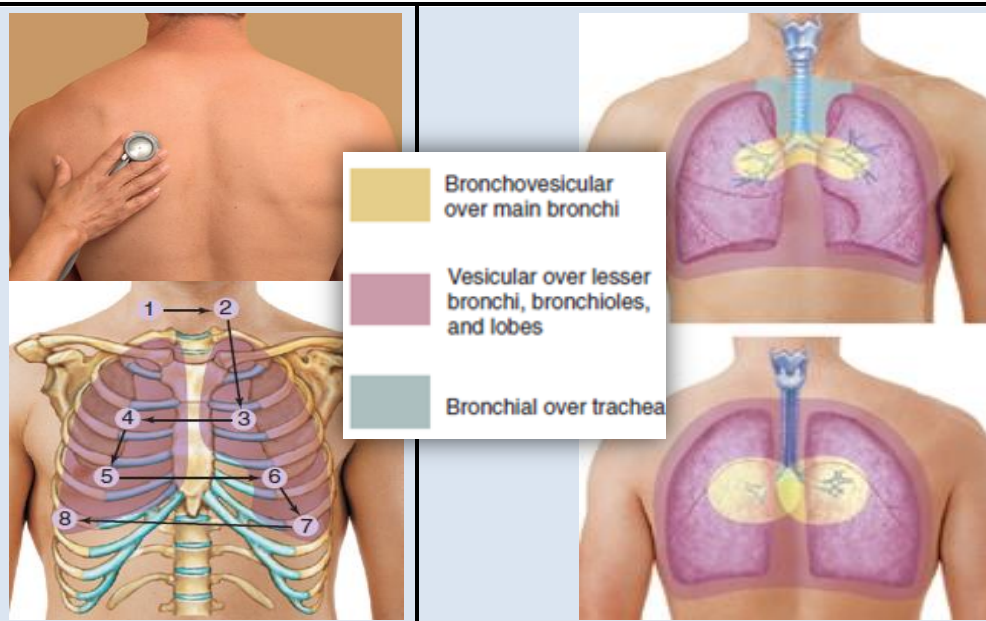
- Intensity, pitch, duration, and quality of breathe sounds.

- normal lung sound; three sound see (table 11-2)

- Amphoric or cavernous breathing. Sounds difficult to hear or absent. Crackles, rhonchi, wheezes, or pleural friction rub, as described in (table 11-3)

When there is an indication of consolidation within the lung or if there was an abnormal finding when tactile fremitus was performed, evaluate for vocal resonance. Three techniques are included: testing for absence of as showed below:

- **Bronchophony**
- **Whispered pectoriloquy**
- **Egophony test**



### Test for vocal resonance

#### 1- Bronchophony Test:

**Procedure:** Instruct the patient to repeat one of the following phrases: “ninety-nine,” “e-e-e,” or “one-two-three.” While the patient is speaking, use the diaphragm of the stethoscope to systematically auscultate the posterior thorax to listen for the response.

**Findings:** The expected response is a muffled tone such as “nin-nin” or muffled “one-two-three.”

#### 2- Whispered Pectoriloquy Test:

**Procedure:** Perform this procedure when there is a positive finding of bronchophony. It is used to more clearly specify the problem and is referred to as an exaggerated bronchophony. Ask the patient to whisper “one-two-three.” Systematically auscultate the posterior thorax, listening for the quality of the whispered tones.

**Findings:** The expected response is a muffled “one-two-three.”

#### 3- Egophony Test:

**Procedure:** It evaluates the intensity of the spoken voice. Instruct the patient to say “e-e-e” as you auscultate the posterior thorax.

**Findings:** The expected response is the sound of a muffled “e-e-e.”



## Percussion Tones Heard Over the Chest

Table 3

Type of Tone	Intensity	Pitch	Duration	Quality
Resonant	Loud	Low	Long	Hollow
Flat	Soft	High	Short	Extremely dull
Dull	Medium	Medium-high	Medium	Thud-like
Tympanic	Loud	High	Medium	Drum-like
Hyperresonant*	Very loud	Very low	Longer	Booming

TABLE 11-2 CHARACTERISTICS OF BREATH SOUNDS

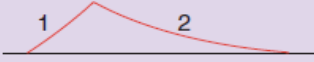

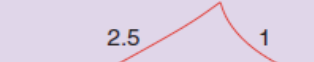


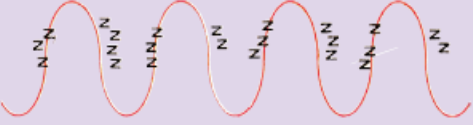

	BRONCHIAL	BRONCHOVESICULAR	VESICULAR
<b>Pitch</b>	High	Moderate	Low
<b>Intensity</b>	Loud	Medium	Soft
<b>Duration: Inspiration and expiration</b>	Insp < Exp 1:2 	Insp = Exp 1:1 	Insp > Exp 2.5:1 
<b>Expected location</b>	Over trachea	First and second intercostal spaces at sternal border anteriorly; posteriorly at T4 medial to scapula	Peripheral lung fields
<b>Abnormal location</b>	Over peripheral lung fields	Over peripheral lung fields	Not applicable

TABLE 11-3 CHARACTERISTICS OF ABNORMAL LUNG SOUNDS

ADVENTITIOUS SOUNDS	CHARACTERISTICS	CLINICAL EXAMPLES
<b>Crackles</b> (previously called <i>rales</i> )		
<b>Fine crackles</b> 	Fine, high-pitched crackling and popping noises (discontinuous sounds) heard during the end of inspiration; not cleared by cough	May be heard in pneumonia, heart failure, asthma, and restrictive pulmonary diseases
<b>Wheeze</b> (also called <i>sibilant wheeze</i> ) 	High-pitched, musical sound similar to a squeak; heard more commonly during expiration but may also be heard during inspiration; occurs in small airways	Heard in narrowed airway diseases such as asthma
<b>Rhonchi</b> (also called <i>sonorous wheeze</i> ) 	Low-pitched, coarse, loud, low snoring or moaning tone; actually sounds like snoring; heard primarily during expiration but may also be heard during inspiration; coughing may clear	Heard in disorders causing obstruction of the trachea or bronchus such as chronic bronchitis
<b>Pleural friction rub</b> 	Superficial, low-pitched, coarse rubbing or grating sound; sounds like two surfaces rubbing together; heard throughout inspiration and expiration; loudest over the lower anterolateral surface; not cleared by cough	Heard in individuals with pleurisy (inflammation of the pleural surfaces)