

# RESPIRATORY SYSTEM

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## OBJECTIVE/RATIONALE

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To pursue a career in health care, proficiency in anatomy and physiology is vital. The student will describe biological and chemical processes that maintain homeostasis; analyze forces and the effects of movement, torque, tension, and elasticity on the human body; associate the disease process with changes in homeostasis; identify changes in structure and function due to trauma and disease; and identify normal and abnormal anatomy and physiology.

TEKS: 121.3 (c)(1)(F)(H),  
121.4 (c)(1)(G)(H)(I),  
121.5 (c)(1)(E)(F)(G)

TAKS: ELA 1, 4  
Mathematics 1, 2, 8, 9  
Science 2, 4

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## KEY POINTS

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### Powerpoint

- I. Introduction
  - A. Of all the substances the body must have to survive, oxygen is by far the most critical.
    - 1. Without food - live a few weeks
    - 2. Without water - live a few days
    - 3. Without oxygen - live 4 – 6 minutes
    - 4. Arterial blood = 21% oxygen
    - 5. Venous blood = 16% oxygen, 5% loss per cycle
    - 6. Clinical death = the moment breathing and heartbeat stop vs. Biological death = when brain cells dies, irreversible after 6 – 10 minutes
  - B. Constant removal of carbon dioxide is just as important for survival - maintaining homeostasis
  - C. Organs of respiration serve 3 functions
    - 1. Distribute air: gets air close enough to the blood for the gas exchange (O<sub>2</sub> load and CO<sub>2</sub> unload)
    - 2. Gas exchanger: by diffusion, higher to lower concentration (cellular respiration)
    - 3. Air purifier: filters, warms, humidifies air we breathe
  - E. System = nose/mouth, pharynx, larynx, trachea, bronchi, alveoli, lungs
- II. Processes of Respiration
  - A. Pulmonary Ventilation (breathing): moving air in and out of lungs
  - B. External Respiration: gas exchange between blood and alveoli
  - C. Transport of Respiratory Gases: cardiovascular system with blood as the transporting fluid
  - D. Internal Respiration: exchange of gases between blood and tissue cells

- III. Zones of Respiratory System
  - A. Conducting Zone: conduits by which air reaches sites of gas exchange; cleanse, humidify, warm incoming air
  - B. Respiratory Zone: actual site of gas exchange; includes respiratory bronchioles, alveolar ducts, alveoli
- IV. Nasal Cavities and Related Structures: Upper Respiratory Tract
  - A. Function
    - 1. Provides airway for respiration
    - 2. Moistens and warms air
    - 3. Filters air
    - 4. Resonating chamber for speech
    - 5. Olfactory receptors
  - B. Nostrils/Nares: entrance to the nose
  - C. Ala: wing-like flare of nostrils
  - D. Septum: midline partition that divides 2 cavities: mostly cartilage covered by mucous membrane; posterior part is bone including the ethmoid bone
  - E. Cavities
    - 1. Lined with mucous membrane and cilia
    - 2. Rich blood supply - often causes epistaxis
    - 3. Coarse hairs = vibrissae
    - 4. Conchae/turbinates: shelf-like partitions/projections that enhance air turbulence and increase the surface area
    - 5. Olfactory receptors: for smell located in the mucosa; superior part of nasal septum
  - F. Sputum
    - 1. 125 ml. of mucus produced daily
    - 2. Contains lysozymes (enzymes that destroy bacteria)
  - G. Paranasal Sinuses
    - 1. Drain into nasal cavities
    - 2. Lighten skull, warm/moisten air, resonance for voice
    - 3. Frontal, sphenoid, ethmoid, maxillary
    - 4. Rhinitis: inflammation of the nasal passages
    - 5. Sinusitis: inflammation of the sinuses
  - H. Nasolacrimal Ducts
    - 1. Convey tears into the nose
    - 2. Add moisture to humidify the air
    - 3. Contain lysozyme (destroys bacteria)
  - I. Nasal Bones: form bridge of nose; the rest of the nose is cartilage
  - J. Floor of Nose: formed by palatine bones
- V. Pharynx and Tonsils: Upper Respiratory Tract
  - A. Structure
    - 1. Throat
    - 2. 5 inches long
    - 3. Connects nose and mouth to the larynx and esophagus
  - B. Nasopharynx
    - 1. Upper portion behind the nasal cavity

2. Soft palate and uvula close it off during swallowing so food doesn't enter nose
3. Contains pharyngeal tonsils (adenoids): protects body from bacterial infection; enlarged can block airway and cause snoring and sleep apnea
4. Contains Eustachian tube: drains middle ear and equalizes pressure; almost horizontal in infants and toddlers - increased risk of ear otitis media

#### C. Oropharynx

1. Behind oral cavity
2. Receives both food and air from the mouth
3. Contains the palatine tonsils: large mass of lymphatic tissue (removal due to repeated tonsillitis)
4. Contains the lingual tonsils (on back of tongue)
5. Uvula: small flap hanging down from the soft palate

#### D. Laryngopharynx

1. Receives both food and air from the mouth
2. Opens into the esophagus (posterior) and the larynx (anterior)

### VI. Larynx: Upper Respiratory Tract

#### A. Voicebox

B. 2 inches long; extends into the trachea

C. Lined with ciliated mucous membrane

#### D. Function

1. Provide patent (open) airway
2. Act as a switching mechanism to route food and air into the proper tube
3. Voice production

#### E. Has a framework of 9 cartilage rings

1. Joined by ligaments, lined with mucous membrane
2. Controlled by skeletal muscle
3. Epiglottis: flap of cartilage that closes the trachea during swallowing; elastic cartilage; "guardian of the airways"
4. Thyroid cartilage: Adam's apple; larger in males
5. Cricoid cartilage: signet ring shaped cartilage; lowest cartilage; used to assist in opening the airway especially for intubation

#### F. Vocal Folds

1. True vocal cords
2. Ligaments attaching arytenoids cartilages to the thyroid cartilage
3. Glottis: space/opening between the vocal cords; narrowest part of the laryngeal cavity
4. Speech: air from lungs vibrate the vocal cords
  - a. Depth of voice depends on the length and thickness of the vocal folds
    - (1) Longer/thicker = slower vibrations = deep voice of male

(2) Shorter/thinner = faster vibrations = high pitch voice of female

b. Loudness of voice depends on force with which air rushes across the vocal cords

5. Valsalva's maneuver: attempt to forcibly exhale with the glottis, nose, and mouth closed; causes increased intrathoracic pressure, slowing of the pulse, decreased return of blood to the heart; contraction of abdominal muscles simultaneously aids in emptying bladder or rectum and stabilizes body trunk when lifting heavy item i.e squat lifts of weight lifters

6. Laryngitis: inflammation of vocal cords

## VII. Trachea: Lower Respiratory Tract

A. Windpipe

B. Location: in front of the esophagus; from larynx to primary bronchi

C. Anatomy

1. 4 inches long, 1 inch in diameter

2. Tube containing C-shaped cartilages (15-20) to keep it open and to allow the esophagus to bulge when swallowing (open part of the C is on the dorsal surface)

3. Lined with ciliated mucous membrane containing goblet cells

4. Carina: last tracheal cartilage; highly sensitive so that foreign objects contacting it cause violent coughing

5. Smoking inhibits then destroys cilia - coughing is then the only means to rid lungs of mucus (Smoker's cough)

D. Tracheal Obstruction

1. Kills over 4000 people each year

2. 5<sup>th</sup> major cause of accidental death in the United States

3. Rx = Heimlich Maneuver

## VIII. Bronchi and Bronchioles: Lower Respiratory Tract

A. Trachea branches at carina into 2 major airways: Right and Left Primary Bronchi

B. Anatomy

1. Right is shorter, wider, more vertical - more aspirations occur here

2. Hilus: notch where each bronchus enters the lung

3. Secondary bronchi = branches of primary bronchi

4. Bronchioles = smallest branches of bronchi

5. Complex branching arrangement

6. 23 branches in each lung

a. 16 bronchi, bronchioles, terminal bronchioles

b. 7 respiratory bronchioles, alveolar ducts, alveolar sacs

7. Anatomical dead space: respiratory structures leading to the respiratory bronchioles; air contained in these structures following inspiration does not reach the alveoli and will be exhaled (150 ml.)

a. Conducting zone

- b. Rule of thumb: anatomical dead space = person's weight in pounds in healthy young adult
    - c. Alveolar dead space: when alveoli cease to act as gas exchange i.e. collapse or filled with mucus
- IX. Alveoli: Lower Respiratory Tract
  - A. Air Sacs at the End of the Alveolar Ducts
  - B. Beyond the Bronchioles
  - C. Anatomy
    - 1. Adult has 1000 square feet of alveolar membrane or 300 million alveoli
    - 2. Surrounded by rich capillary network (60 square meters = half of a tennis court) for exchange of oxygen and carbon dioxide between the blood and lungs
    - 3. Pulmonary (respiratory) membrane: space between the alveoli and the pulmonary capillaries
    - 4. Movement by diffusion (high concentration to low concentration) with enormous surface area and permeability of the membrane
    - 5. Surfactant: lines the respiratory membrane of the alveoli
      - a. Interferes with the cohesiveness of water molecules to reduce the surface tension of the alveolar fluid
      - b. Infant Respiratory Distress Syndrome (IRDS) (Hyaline Membrane Disease): insufficient amounts of surfactant (especially in preemies) causes alveoli to collapse
    - 6. Reduction in alveolar surface area
      - a. Emphysema: walls of adjacent alveoli break through and alveolar chamber become larger
      - b. Tumors, mucus, inflammatory material block gas flow into alveoli
- X. Lungs
  - A. Spongy Organs in the Right and Left Pleural Cavities of the Chest
  - B. Right Lung
    - 1. Three lobes
    - 2. Superior, Middle, Inferior
  - C. Left Lung
    - 1. Two Lobes
    - 2. Superior, Inferior
  - D. Apex, Base, Costal Surface
    - 1. Tip above the first rib
    - 2. Sits on diaphragm
    - 3. Against the ribs
  - E. Hilus: indentation through which blood vessels enter and leave the lung
  - F. Lobule: smallest subdivision of the lung that can be seen with the naked eye
  - G. Pleura
    - 1. Membrane, sac enclosing each lung

2. Thin, double layered serosa
    - a. Parietal: lines the thoracic wall and superior aspect of the diaphragm
    - b. Visceral: covers external lung surface
    - c. Pleural fluid: lubricating secretion
  3. Pleurisy: inflammation of the pleura; dry is more painful than excessive fluid type
- H. Mediastinum: space between the lungs containing the heart
- XI. Diaphragm
- A. Muscle that Separates the Lower Portion of the Thoracic Cavity from the Abdomen
  - B. Contract to Draw Air into the Lungs
- XII. Mechanism of Breathing: Respiratory Cycle = Inspiration + Expiration
- A. Inspiration
    1. Diaphragm contracts and descends
    2. External intercostals muscles contract to raise the ribs
    3. Intrapulmonic and intrapleural pressures decrease - air enters lungs until intrapulmonic pressure equals atmospheric pressure
  - B. Expiration
    1. Passive action
    2. Diaphragm and intercostals muscles relax
  - C. Pressures Involved
    1. Atmospheric pressure
    2. Intrapulmonic pressure (within the alveoli)
    3. Intrapleural (intrathoracic) pressure
    4. Atelectasis: lung collapse as a result of intrapleural pressure = intrapulmonic or atmospheric pressure
    5. Pneumothorax: presence of air in intrapleural space; reversed by closing hole and drawing air out of intrapleural space with chest tubes
  - D. Nervous System
    1. Involuntary nervous control regulates depth of respiration and volume of air
    2. Respiratory center in **Medulla** (controls rate and depth of respirations; stimulated by increase in CO<sub>2</sub> in the blood, decrease of CO<sub>2</sub> in the blood and increase of O<sub>2</sub> in the blood) send impulses by the **Phrenic Nerve** to the **Diaphragm** and **Intercostal Muscles** and stimulates them to contract and draw air into the lungs (**Inspiration**)
    3. **Stretch Receptors** in lung tissue send impulses by the **Vagus Nerve** to the brain to **Inhibit** respiration - lungs recoil/deflate = **expiration (Hering-Breuer Reflex)**
  - E. Chemical: Involuntary Control
    1. **Carbon dioxide** in the body is found mostly as **carbonic acid** (CO<sub>2</sub> + H<sub>2</sub>O = H<sub>2</sub>CO<sub>3</sub>) and some bicarbonate in the plasma
    2. Normal pH of blood is 7.35 – 7.45 (pH scale 1 – 14)

3. **Chemoreceptors** in the **aortic arch, carotid artery**, and **medulla** are sensitive to the level of CO<sub>2</sub> (pH)
  - a. **CO<sub>2</sub> buildup (decreased pH)** caused by any disorder that impairs ventilation triggers the Chemoreceptors and sends an impulse to the respiratory muscles to contract and **Increase Respirations**. You breathe faster to **Decrease CO<sub>2</sub>** and **Increase pH**.
    - (1) **Respiratory Acidosis**: condition of CO<sub>2</sub> buildup (hypercapnea)
    - (2) S & S: headache, confusion, N&V, arrhythmias
    - (3) Dx: PaO<sub>2</sub> over 45 mm Hg, pH < 7.35
    - (4) Chronic increase in PCO<sub>2</sub> leads to decreased PO<sub>2</sub> so the chemoreceptors provide the respiratory stimulus = hypoxic drive (declining O<sub>2</sub> provide the respiratory stimulus instead of increasing CO<sub>2</sub> levels)
    - (5) Caused by pulmonary disease in which CO<sub>2</sub> is retained i.e. emphysema, bronchitis which create an increased anatomical dead space
  - b. **Decreased CO<sub>2</sub>** level (increased pH, hypocapnea) occurs when the body eliminates too much CO<sub>2</sub> (as in **Hyperventilation**). The Chemoreceptors are triggered to stimulate the **Vagus Nerve** to **Decrease Respirations**. You breathe slower to **Increase CO<sub>2</sub>** and **Decrease pH**.
    - (1) **Respiratory Alkalosis**
    - (2) Lowers PCO<sub>2</sub>
    - (3) 20:1 ration of bicarbonate to carbonic acid becomes 40:1 ratio - pH rises
    - (4) Caused by inexperienced mountain climbers and anxiety induced hyperventilation
    - (5) Compensations: stop hyperventilation and kidneys begin eliminating more bicarbonate

### XIII. Factors Facilitating Combining of O<sub>2</sub> with Hemoglobin (Hgb)

#### A. pH of Blood

1. Alkaline favors combining of O<sub>2</sub> and Hgb
2. Acid favors dissociation of O<sub>2</sub> from Hgb
3. CO<sub>2</sub> + H<sub>2</sub>O = H<sub>2</sub>CO<sub>3</sub> (carbonic acid)
4. In lungs, CO<sub>2</sub> and H<sub>2</sub>O are being expelled creating an alkaline environment
5. In tissues, CO<sub>2</sub> is being produced creating an acid environment

#### B. Temperature of Blood

1. Increased temperature in peripheral tissues favors dissociation of O<sub>2</sub>
2. Increased temperature in lungs favors combining

### XIV. Gas Transport

- A. CO<sub>2</sub> mainly as bicarbonate and carbonic acid in plasma

- B. O<sub>2</sub> mainly as potassium oxyhemoglobin in the RBCs
- XV. Pulmonary Ventilation
  - A. Spirometer: instrument used to measure the volume of air exchanged in breathing
  - B. Spirogram: graphic recording of changing volumes
  - C. **TV** = Tidal Volume: approximately 500 ml (1 pint); the amount of air moved in and out of the lungs during normal quiet breathing
  - D. **IRV** = Inspiratory Reserve Volume: approximately 2100 – 3300 ml; the amount of air that can be forcibly inspired over and above normal inspiration
  - E. **ERV** = Expiratory Reserve Volume: approximately 1000 – 1200 ml; the amount of air that can be forcibly exhaled after expiring the tidal volume
  - F. **VC** = Vital Capacity: approximately 4500 – 4800 ml.; the largest amount of air that we can breathe in and out in one respiratory cycle; total amount of exchangeable air;  $TV + IRV + ERV$
  - G. **RV** = Residual Volume: approximately 1200 ml.; air that remains in the lungs after a forceful expiration; helps maintain alveolar patency and prevents lung collapse
  - H. **IC** = Inspiratory Capacity: total amount of air that can be inspired after tidal expiration;  $TV + IRV$
  - I. **FRC** = Functional Residual Capacity: combined residual and expiratory reserve volume; amount of air remaining in lungs after tidal expiration
  - J. **TLC** = Total Lung Capacity: approximately 6000 ml in males; sum of all lung volumes;  $TLC = VC + RV$
- XVI. Types of Breathing
  - A. Eupnea: normal, quiet breathing
  - B. Apnea: cessation of breathing
  - C. Hyperpnea: abnormally increased rate of breathing
  - D. Cheyne-Stokes: respirations gradually increase then cease entirely for a few seconds
  - E. Rales: rattling, gurgling sounds heard with breathing
  - F. Hyperventilation: depth and rate of breathing are increased
  - G. Hypoventilation: slow, shallow breathing
- XVII. Pulmonary Diagnostics/Procedures
  - A. Roentgenography
    1. X-rays
    2. Anteroposterior (AP) and lateral views
  - B. Tomography
    1. Body section X-rays
    2. Different depths of thoracic cavity
    3. Defines shape, size, and borders of lesions
  - C. Fluoroscopy: views thoracic cavity in motion
  - D. Sputum Specimens
    1. Diagnose infections
    2. Checks for microbes and antibiotic effectiveness
    3. Detect abnormal cells from tumors

- E. Bronchoscopy
  - 1. Visualize upper airway and bronchi
  - 2. Obtain biopsy specimens
  - 3. Remove aspirated foreign bodies
  - 4. Procedure:
    - a. Patient sedated and given local anesthetic
    - b. Rigid, hollow instrument passed into trachea into bronchi
    - c. Fiber optics used
- F. Bronchogram: radiopaque substance injected into trachea, patient tilted various ways and X-rays taken
- G. Tuberculin Test
  - 1. 6 – 8 weeks after body invaded by tubercle bacillus, body develops allergy to organism
  - 2. Skin tests reveal this reaction
- H. Lung Scans: inhale or IV gamma ray emitting device and then scanned; visual exam with dye to check ventilation and perfusion
- I. Pulmonary Angiography
  - 1. Catheter with radiopaque dye
  - 2. Through pulmonary artery
  - 3. Search for pulmonary embolus
- J. Pulmonary Function Tests: spirometry; to test movement of air in/out of alveoli or O<sub>2</sub>/CO<sub>2</sub> diffusion
- K. ABG's = arterial blood gases
- L. Phrenic Pacemaker
- M. Tracheotomy/Tracheostomy
- N. Postural Drainage
- O. Surgical Resection: Pneumonectomy, Lobectomy
- P. Thoracic Deformities
- Q. Pulse Oximetry
  - 1. Infrared light source measures light changes of arterial blood and measures peripheral oxygen saturation of Hgb (SaO<sub>2</sub>)
  - 2. Hgb is the oxygen carrier in the blood and maintains a normal saturation of 97 – 99%
    - a. At 92 – 96% the pt needs supplemental oxygen
    - b. At 86 – 91% the pt is experiencing moderate to severe hypoxemia
    - c. Below 85% the pt need ET intubation and BVM or ventilator
    - d. Below 70% is life threatening!
  - 3. COPD has a “normal” SaO<sub>2</sub> of 92% (NOT EVER BETTER!)
  - 4. High altitude normal is 92%
  - 5. False readings can be caused by
    - a. CO Poisoning: CO binds with Hgb better than O<sub>2</sub>, but oximeter doesn't know the difference
    - b. Dyshemoglobin: drugs that bind with Hgb
    - c. Hypothermia

- d. Hypovolemia/shock
- e. Aggressive fluid replacement
- f. High intensity lightning

R. Hyperbaric Oxygen Chambers

- 1. Contain oxygen at pressures greater than 1 atm.
- 2. Used to force greater than normal amounts of oxygen into patient's blood in cases of CO poisoning, circulatory shock, asphyxiation, gas gangrene, tetanus poisoning
- 3. Oxygen toxicity can result: large amounts of free radicals, profound central nervous system disturbances, coma, death

XVIII. Diseases/Disorders of the Respiratory System

A. Dyspnea: a Symptom

- 1. Causes: airway obstruction, hypoxia, pulmonary edema, lung diseases, heart conditions, allergic reactions, pneumothorax, poisoning (CO)
- 2. Respiratory Distress
  - a. Pt begins to increase rate and depth of respirations
  - b. Followed by SOB (dyspnea)
  - c. Hypoxia may follow because of decreased O<sub>2</sub>
  - d. Pt begins gasping for air, has blurred vision, is cyanotic
  - e. Increased blood CO<sub>2</sub> stimulates medulla to increase respirations, but with time the medulla is depressed and breathing rate slows
  - f. If untreated, apnea occurs
  - g. If onset is slow, Cheyne-Stokes develops
  - h. Then respiratory arrest to unconsciousness
  - i. Pupils dilate and pt goes into cardiac arrest
  - j. Pt has suffocated = asphyxia
- 3. Treatment
  - a. Interview, medical ID, look for S & S
  - b. ABC's, treat for shock, O<sub>2</sub> (BVM if needed)

B. Hyperventilation: Breathing Too Rapidly and Too Deeply

- 1. S & S
  - a. Carpopedal spasms (tingling, cramping of upper extremities)
  - b. Chest pain, anxiety
  - c. Perioral numbness, but not cyanotic
- 2. CO<sub>2</sub> level is too low so treat by having pt. breathe into a paper bag
- 3. If breathing is shallow, it's not hyperventilation

C. Epistaxis: Nosebleed

- 1. Blood vessels close to surface, so bleeding looks profuse
- 2. Treatment: pinch nostrils, lean forward, ice to neck

D. URI: Upper Respiratory Infection, Usually Viral

- 1. Sinusitis
- 2. Laryngitis

- E. Laryngectomy: Usually From Cancer of Larynx
  - 1. Airway must be rerouted by stoma formed by tracheotomy (tracheostomy is permanent)
  - 2. Must use electronic voice box
  - 3. CPR - bag to stoma
- F. Pneumonia: Lung Infection - Viral, Bacterial, Fungal
  - 1. S & S: fever, cough, chills, headache, myalgia, NVD, rash, dyspnea
  - 2. Tx: antivirals, antibiotics, antifungals
- G. Pleurisy
  - 1. Inflammation of pleura surrounding lung
  - 2. Fluid can be removed by thoracentesis
- H. Epiglottitis
  - 1. Usually in small children
  - 2. Signs: drooling, tripod position
  - 3. Tx: transport ASAP, do NOT try to look in the mouth
- I. Pulmonary Embolism/Infarction
  - 1. A moving clot into the vessels of the lungs
  - 2. Lung tissue gets deprived of O<sub>2</sub>
  - 3. At risk: recent post-operatives, immobile pts, those on birth control pills, trauma, blood clots in the legs, heart valve replacement pts
- J. Atelectasis: Imperfect Expansion = Collapsed Lung
- K. Pneumothorax
  - 1. Air in thoracic cavity, lungs collapse
  - 2. Trauma - lungs punctured by ribs or other sharp object
  - 3. Spontaneous - weakened area of lung ruptures and releases air into thoracic cavity; more common in young, thin males; also occurs after surgery; Ca
  - 4. Tension - collapsed lung gets pushed against heart and great vessels and other lung - **TRUE EMERGENCY!**
    - a. S & S: dyspnea, sharp pain prior to onset, weak rapid pulse, hypotension, uneven chest expansion (flail chest), neck vein distention, trachea will deviate to side opposite ruptured lung
    - b. TX: high O<sub>2</sub>, transport ASAP, lift occlusive dsg
- L. Tuberculosis
  - 1. Bacterial infection of lungs: Mycobacterium tuberculosis
  - 2. Epidemic in Texas
  - 3. S & S: cough, hemoptysis, low grade fever
  - 4. Tx: long term antibiotic therapy; lobectomy of affected lung
- M. Influenza
  - 1. Viral infection
  - 2. Very contagious
  - 3. S & S: fever, headache, malaise, cough
  - 4. Tx: antivirals

5. Prevention: yearly immunization

N. Asthma

1. Episodic spasms of muscles of bronchi cause constriction
2. Interferes with expiration of air
3. Mucus overproduces and is thick so air flow decreases on exhalation and air is trapped in lungs
4. Pt must exhale forcefully, producing the characteristic wheezing sound on expiration
5. S & S: no chest pain usually, pt is tense/anxious/frightened, wheezing on expiration, increased pulse rate 120+, normal rhythm, neck veins distended, cyanosis, coughing
6. Tx: reassure and clam pt, check medications inhalant, position upright, O<sub>2</sub>, transport
7. Prolonged attack = status asthmaticus - **Can be fatal!**

O. COPD: Chronic Obstructive Pulmonary Disease (common features: hx of smoking, dyspnea, coughing, frequent infections, respiratory failure)

1. Chronic bronchitis
  - a. Bronchiole lining inflamed
  - b. Excess mucus produced but cilia are scarred/paralyzed
  - c. Inhaled irritants
  - d. S & S: persistent cough, SOB, tightness in chest, dizziness, periodic cyanosis, “blue bloaters”
2. Emphysema
  - a. Chronic, alveoli lose elasticity and air is trapped in the alveoli, alveoli rupture then fuse into large irregular spaces
  - b. Excess mucus produced
  - c. Poor gas exchange
  - d. S & S: dyspnea on exertion, chronic cough, rapid pulse, irregular, B/P normal, wheezing, breathe with pursed lips, develop barrel-chest appearance due to trapped air, “pink puffers”
  - e. CO<sub>2</sub> narcosis: medulla becomes insensitive to increased CO<sub>2</sub> levels over time and only peripheral receptors respond
3. Bronchiectasis
  - a. Bronchi and bronchioles widen so blood is not O<sub>2</sub> rich therefore pt is dyspneic, cyanotic, with foul greenish sputum
4. Cystic fibrosis
  - a. Pancreatic enzyme deficiency causes increased mucus glands, increased viscosity of mucus, more secretions and infections, scarring of membranes
  - b. Inherited
  - c. Tx: monitor VS, orthopnic position, loosen restrictive clothing, keep pt warm but not overheated, decrease stress, O<sub>2</sub> (chronic: postural drainage)

P. ARDS

1. Adult respiratory distress syndrome
  2. “Shock lung” due to trauma
  3. S & S: grunting respirations, dyspnea
- Q. IRDS: Infant Respiratory Distress Syndrome
1. Causes: SIDS, Hyaline Membrane Disease (surfactant deficiency)
  2. Life threatening disorder
- R. Occupational Lung Disorders
1. Pneumoconiosis: inhaled dust
  2. Silicosis: silica dust (gold, coal)
  3. Asbestosis: fibers
  4. Black lung disease: coal miners’ lungs
- S. Lung Cancer
1. Squamous cell carcinoma: epithelial cells in bronchi
  2. Adenocarcinoma: peripheral lung areas
  3. Oat cell carcinoma: aggressive
- T. Cleft Palate
- U. Deviated Septum
- V. Hanta Virus Pulmonary Syndrome

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### ACTIVITIES

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- I. Create Jeopardy game questions and participate in game.
- II. Build a working lung.

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### MATERIALS NEEDED

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2 liter empty, clean Gatorade bottles  
9” helium balloons  
Latex gloves

**Jeopardy Game Template**

**Respiratory System Terminology**

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### ASSESSMENT

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**Respiratory System Test**

Participation in Jeopardy game

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### ACCOMMODATIONS

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For reinforcement, the student will label a diagram of the lungs then make flashcards of the terminology.

For enrichment, the student will research and report on a **respiratory disease/disorder**.

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## REFLECTIONS

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## **Creation of a Working Model of the Lung**

1. Carefully slice the bottoms off of the Gatorade bottles up to the indentation of the first segment of the bottle. (2 liter coke, DP bottles can be used but the plastic is sometimes too flimsy.)
2. Insert one balloon into the neck of the bottle and pull the lip of the balloon over the lip of the bottle.
3. Place the latex glove over the open base of the bottle.
4. Pull on the fingers to simulate the contraction of the diaphragm and watch the “lung” fill with air.
5. Release the finger of the glove to simulate exhalation.
6. Punch hole in side of bottle to demonstrate a pneumothorax, then place finger over the hole to demonstrate the effectiveness of an occlusive dressing.

# Respiratory System Test

## Matching

- A. Alveoli
- B. Pleura
- C. Breathing
- D. Pulmonary
- E. Expiration
- F. Respiration
- G. Internal Respiration
- H. Surfactant
- I. Inspiration
- J. Thoracic

1. Thin tissue covering the lungs and lining the chest cavity \_\_\_\_\_
2. To breathe in \_\_\_\_\_
3. Minute, balloonlike sacs in the lung through which oxygen and carbon dioxide are exchanged \_\_\_\_\_
4. Pertaining to the chest region \_\_\_\_\_
5. The interchange of gases between organisms and the environment; the taking in of oxygen and the giving off of carbon dioxide \_\_\_\_\_
6. Mechanical process by which atmospheric air is taken in and waste air is expelled \_\_\_\_\_
7. Pertaining to the lungs \_\_\_\_\_
8. Phospholipid produced by the alveoli that forms a lining that prevents the thin membranes of the alveoli from sticking together by decreasing the surface tension \_\_\_\_\_
9. To breathe out \_\_\_\_\_
10. The exchange of gases between the body and the blood cells \_\_\_\_\_

- A.Oxygen
- B.Pollutants
- C.Carbon dioxide
- D.Tuberculosis
- E.Asthma
- F.Pneumonia
- G.Emphysema

- 11.Alveoli are stretched and unable to force carbon dioxide out\_\_\_\_\_
- 12.Essential life giving element\_\_\_\_\_
- 13.The walls of the bronchial tubes become narrow and less air passes through them\_\_\_\_\_
- 14.Waste product of the cell\_\_\_\_\_
- 15.Inflammation of the lungs\_\_\_\_\_
- 16.Unclean\_\_\_\_\_
- 17.Infection that can be determined by a PPD test or a CXR; opportunistic infections especially among AIDS patients\_\_\_\_\_

#### Multiple Choice

- 18.The special piece of cartilage that closes the opening of the larynx during swallowing is called
- a.epiglottis
  - b.epistaxis
  - c.thyroid cartilage
  - d.glottis
- 19.The pouch containing a cordlike framework that creates voice sounds is called
- a.pharynx
  - b.oral cavity
  - c.larynx
  - d.trachea

20. The hairlike objects that help move mucus, dust, and pathogens up and out of the lungs are called
- a. ronchi
  - b. cilia
  - c. glottis
  - d. conchae
21. The muscular wall that divides the chest cavity from the abdominal cavity is called the
- a. intercostals
  - b. myocardium
  - c. deltoid
  - d. diaphragm
22. External respiration occurs in the
- a. cells of the body
  - b. in the left atrium
  - c. in the alveoli
  - d. in the nose
23. Internal respiration occurs in the
- a. cells of the body
  - b. in the left atrium
  - c. in the alveoli
  - d. in the nose
24. The turbinates (conchae) that increase the surface area of the nasal cavity aide in doing all of the following EXCEPT
- a. warm the air
  - b. moisten the air
  - c. filter the air
  - d. add nutrients
25. The following are the 4 paranasal sinuses
- a. occipital, ethmoid, sphenoid, maxillary
  - b. frontal, ethmoid, sphenoid, maxillary
  - c. parietal, maxillary, occipital, ethmoid
  - d. frontal, occipital, sphenoid, mastoid
26. The sinuses give resonance to our voices and lightness to our heads.
- a. True
  - b. False
27. The nasolacrimal ducts transport chyme to our Eustachian tube.
- a. True
  - b. False

28. The tears contain lysozyme which when conveyed into our nasal cavities fights bacterial and viral invasion.
- a. True
  - b. False
29. The Eustachian tube is located between the middle ear and the pharynx to help equalize pressure on both sides of the eardrum.
- a. True
  - b. False
30. The Hering-Breuer reflex makes a person withdraw their hand when heat is applied.
- a. True
  - b. False
31. Anatomical dead space is that area of the respiratory tree in which the air is never used; the air is inhaled and exhaled and never reaches the alveoli.
- a. True
  - b. False
32. Sputum specimens are obtained for the following reasons:
- a. to cleanse the nose and lungs of excess mucus
  - b. to culture the causative agent for a respiratory infection
  - c. to look for cancerous cells from the lungs
  - d. both b and c
33. The nonrespiratory movement characterized by sudden inspiration, resulting from spasms of the diaphragm is called a/an
- a. epistaxis
  - b. sneeze
  - c. cough
  - d. hiccup
34. The nonrespiratory movement where a deep breath is taken, the glottis is closed, and air is forced out of the lungs against the glottis (used to clear the lower respiratory passageways) is called a/an
- a. epistaxis
  - b. sneeze
  - c. cough
  - d. hiccup

35. The nonrespiratory movement that clears the upper respiratory passageways is called  
a/an  
a. epistaxis  
b. sneeze  
c. cough  
d. hiccup

Matching. Each term will be used only once.

- A. Dead space volume
- B. Expiratory reserve volume (ERV)
- C. Inspiratory reserve volume (IRV)
- D. Residual volume (RV)
- E. Tidal volume (TV)
- F. Total lung capacity (TLC)
- G. Vital capacity (VC)

36. Respiratory volume inhaled or exhaled during normal breathing\_\_\_\_\_

37. Total amount of exchangeable air\_\_\_\_\_

38. Gas volume that allows gas exchange to go on continuously\_\_\_\_\_

39. Amount of air that can still be exhaled (forcibly) after a normal exhalation\_\_\_\_\_

40. Sum of all lung volumes\_\_\_\_\_

Matching. The following terms may be used once, more than once, or not at all.

- A. Apnea
- B. Hypoxia
- C. Chronic bronchitis
- D. Lung cancer
- E. Dyspnea
- F. Sleep apnea
- G. Emphysema
- H. Cheyne-Stokes
- I. Eupnea
- J. Rales

- 41. Lack or cessation of breathing\_\_\_\_\_
- 42. Normal breathing in terms of rate and depth\_\_\_\_\_
- 43. Labored breathing, or “air hunger” \_\_\_\_\_
- 44. Chronic oxygen deficiency\_\_\_\_\_
- 45. Respirations gradually increase in rate then cease entirely for a few seconds\_\_\_\_\_
- 46. Condition characterized by fibrosis of the lungs and an increase in size of the alveolar chambers\_\_\_\_\_
- 47. Condition characterized by increased mucus production that clogs respiratory passageways and promotes coughing\_\_\_\_\_
- 48. Together called COPD\_\_\_\_\_
- 49. Incidence strongly associated with cigarette smoking; has increased dramatically in women recently\_\_\_\_\_
- 50. Victims become barrel-chested because of air retention\_\_\_\_\_
- 51. Temporary cessation of breathing during sleep \_\_\_\_\_

Matching. Each term may be used once or not at all.

- A. Bronchioles
- B. Epiglottis
- C. Esophagus
- D. Glottis
- E. Palate
- F. Trachea
- G. Uvula

52. Narrowest portion of the respiratory tree \_\_\_\_\_

53. Smallest respiratory passageways \_\_\_\_\_

54. Closes the nasopharynx during swallowing \_\_\_\_\_

55. Separates the oral and nasal cavities \_\_\_\_\_

56. Windpipe \_\_\_\_\_

57. Food passageway posterior to the trachea \_\_\_\_\_

## Respiratory Diseases and Disorders

- 1.nasopharyngitis: inflammation of the nose and pharynx
- 2.cystic fibrosis: hereditary children's disorder with increased abnormal mucus production
- 3.paranasitis: inflammation of all of the sinuses
- 4.acute coryza: common cold; most widespread of all communicable diseases; characterized by swollen and inflamed mucous membrane of the nose and throat
- 5.tuberculosis: primarily a lung disorder caused by the tubercle bacillus, *Mycobacterium tuberculosis*; extremely contagious
- 6.atelectasis: collapsed lung
- 7.pneumonitis: inflammation of the lung
- 8.thoracalgia: pain in the chest
- 9.rhinorrhea: runny nose
- 10.pleuritis: inflammation of the pleura
- 11.epistaxis: nose bleed; may result from injury, local infections, or drying out of the mucous membrane
- 12.influenza: the flu
- 13.pertussis: whooping cough
- 14.dysphonia: difficulty in speaking
- 15.orthopnea: breather only in an upright position
- 16.pneumonia: severe infection of the lungs
- 17.pleurisy: irritation of pleura, increased amount of pleural fluid; inflammation of the pleura or lining of the lungs and chest cavity; the resulting swelling causes the linings to rub, causing friction and pain
- 18.empyema: pus in the chest (pleural space)
- 19.aphonia: absence of voice
- 20.asthma: chronic respiratory disease, coughing, wheezing due to constricted airways; shortness of breath with wheezing caused by obstruction of the flow of air in small bronchi or bronchioles due to swelling or spasm of the bronchial tubes or their mucous membranes
- 21.anoxia: deficiency of oxygen
- 22.croup: occurs in children; acute obstruction of the larynx
- 23.URI: inflammation of the nose, larynx, bronchus, upper respiratory infection
- 24.cough: mechanism for clearing obstruction from the airway
- 25.rhinomycosis: fungal infection of the nose
- 26.pharyngismus: muscular spasm of the pharynx
- 27.nasogastric tube (NG tube): tube inserted through the nostril into the stomach
- 28.rhinoplasty: plastic surgery of the nose
- 29.nasolabial: pertaining to the nose and lip
- 30.rhinorrhea: free discharge of thin nasal mucus
- 31.tachypnea: very rapid respirations
- 32.bradypnea: abnormal slowness of respiration
- 33.orthopnea: ability to breathe easily only in upright position