Phases of Respiration

We get oxygen from the environment and it goes to our cells, there....

- Pulmonary ventilation
- External exchange of gases
- Internal exchange of gases
Overview of respiration. In ventilation, gases are moved into and out of the lungs. In external exchange, gases move between the air sacs (alveoli) of the lungs and the blood. In internal exchange, gases move between the blood and body cells. The circulation transports gases in the blood.
The Respiratory System

Conducts air into lungs

- Nasal cavities, Pharynx, Larynx, Trachea (windpipe)
The respiratory system.

(A) Overview.

(B) Enlarged section of lung tissue showing the relationship between the alveoli (air sacs) of the lungs and the blood capillaries.

(C) A transverse section through the lungs.
Question:

True or False?: The two gases involved in the external exchange of gases that takes place in the respiratory system are $\text{CO}_2$ and $\text{O}_2$. 
The Nasal Cavities

- Nostrils (nares)
- Nasal cavities
  - Mucous membrane: Filters foreign bodies, Warms and Moistens air
  - Conchae
- Nasal septum
- Sinuses
Checkpoint 18-2: What happens to air as it passes over the nasal mucosa?
Throat (pharynx) carries air to respiratory tract and food to digestive system

- Nasopharynx: Superior portion
- Oropharynx: Middle portion
- Laryngeal pharynx: Inferior portion
The Larynx

Larynx (voice box) is located between the pharynx and trachea

- Cartilage framework: Thyroid cartilage (Adam’s apple)
- Vocal folds (vocal cords): Used for speech
- Glottis
- Epiglottis
The Trachea

Trachea (wind pipe) conducts air between larynx and lungs

- Framework of separate cartilages
- Horseshoe shaped
- Open at back for expansion during swallowing
The Bronchi

- Trachea divides into two primary bronchi that enter the lungs:
  1. Hilum
  2. Epithelial tissue lining
Question:

The air-conducting passageways of the respiratory tract are lined with what type of tissue?

a. stratified squamous epithelial
b. pseudostratified epithelial
c. squamous epithelial
The Lungs

- Mediastinum
- Lobes
  - Bronchial tree
  - Bronchioles
- Alveoli
- Diaphragm
- Pleura
  - Parietal
  - Visceral
  - Pleural space
The Process of Respiration

- Ventilation of lungs
- Exchange of gases
- Transport of gases in blood
Pulmonary Ventilation

- Inhalation (inspiration) is **active** phase
- Compliance
- Exhalation (expiration) is **passive** phase
- Lung capacity
Pulmonary ventilation.

(A) Inhalation.
(B) Exhalation.

During inhalation the diaphragm presses the abdominal organs downward and forward.

A. Action of rib cage in inhalation

During exhalation the diaphragm rises and recoils to the resting position.

B. Action of rib cage in exhalation
Gas Exchange

- Diffusion is movement of molecules from higher to lower concentration (remember the pool)
- External exchange
  - Gases move between alveoli and capillary blood
- Internal exchange
  - Gases move between blood and tissues
Gas exchange. (A) External exchange between the alveoli and the blood. Oxygen diffuses into the blood and carbon dioxide diffuses out, based on concentrations of the two gases in the alveoli and in the blood. (B) Internal exchange between the blood and the cells. Oxygen diffuses out of the blood and into tissues, while carbon dioxide diffuses from the cells into the blood.
Transport of Oxygen

- Most oxygen in capillary blood binds to hemoglobin
- Oxygen must separate from hemoglobin to enter cells
Transport of Carbon Dioxide (relax)…

- 10% is dissolved in plasma and fluid in red blood cells
- 15% is combined with protein of hemoglobin and plasma proteins
- 75% dissolves in blood fluids and is converted to bicarbonate ion
  - First combines with water to form carbonic acid
  - Carbonic acid ionizes (separates) into hydrogen and bicarbonate ions
  - Carbonic anhydrase enzyme speeds conversion
  - Buffers blood to keep pH steady
Question:

In what structure of the respiratory system does most gas exchange take place?

a. bronchioles  
b. pleurae  
c. alveoli
Regulation of Respiration

Fundamental respiratory pattern

- Controlled by central nervous system centers
  - Partly in medulla (main control center), partly in pons (modifies patterns set in the medulla)
- Modified by receptors detecting changes in blood chemistry
Nervous Control

- Control center is located in medulla and pons of brain stem
- Motor nerve fibers extend into spinal cord
- Fibers extend through phrenic nerve to diaphragm
Chemical Control

- Central chemoreceptors
  - Located near medullary respiratory center
  - Respond to raised CO2 level (hypercapnia)

- Peripheral chemoreceptors
  - Located in neck and aortic arch
  - Respond to oxygen level considerably below normal
Abnormal Ventilation

- Hyperventilation
  - High oxygen level and low CO2 level (hypocapnia)
  - Increases blood pH

- Hypoventilation
  - Insufficient air in alveoli
  - Decreases blood pH
Breathing Patterns

- Measured in breaths per minute
- Adults: 12 to 20
- Children: 20 to 40
- Infants: more than 40
Some Terms for Altered Breathing

- Hyperpnea – increase depth and rate
- Hypopnea – decrease depth and rate
- Tachypnea - excessive
- Apnea – temporary cessation
- Dyspnea – labored
- Orthopnea – difficulty (laying)
- Kussmaul respiration – deep, rapid
- Cheyne-Stokes respiration – rhythmic variation & apnea
Question:

What is the medical term for temporary cessation of breathing?

a. dyspnea
b. apnea
c. hypopnea
Results of Inadequate Breathing

- Cyanosis – blue color
- Hypoxia – lower than normal oxygen
- Hypoxemia – lower than normal oxygen in arterial blood
- Suffocation – umm...
Disorders of the Respiratory System

- Infection
- Allergies
- Environmental factors
- Lung cancer
Disorders of the Nasal Cavities and Related Structures

- Paranasal sinuses: Sinusitis & Polyps
- Nasal septum: Deviated septum
- Mucous membranes: Epistaxis (most common cause of bleeding)
Infection

- Upper respiratory infection (URI)
- Common cold (acute coryza)
- Respiratory syncytial virus (RSV): lower resp. tract infection
- Croup: children under 3 years, URI
- Influenza: the flu, URI
- Pneumonia (inflammation of the lungs)
  - Bronchopneumonia
  - Lobar pneumonia
  - Pneumocystis pneumonia (PCP)
- Tuberculosis (bacterial infection)
Hypersensitivity to allergens

- Watery discharge from eyes and nose
- Seasonal or chronic
- Inflammation of airway tissues
- Spasm in bronchial tubes
Chronic Obstructive Pulmonary Disease (COPD)

Also called chronic obstructive lung disease (COLD)

- Includes both chronic bronchitis and emphysema
- Normal air flow obstructed
- Reduced exchange of oxygen and carbon dioxide
- Air trapping and overinflation of lungs
- Dyspnea
Sudden Infant Death Syndrome (SIDS)

Also called crib death
- Unexplained death
- Seemingly healthy infant
- Under 1 year old
- Usually occurs in sleep
Respiratory Distress Syndrome (RDS)

Covers a range of inflammatory disorders

- Acute respiratory distress syndrome (ARDS) or shock lung
  - Usually appears in adults
- Respiratory distress syndrome of the newborn
  - Formerly called hyaline membrane disease
  - Appears in premature newborns
Cancer

• Lung cancer
  – Most common cause of cancer-related deaths
  – Most important cause is cigarette smoking

• Cancer of larynx
  – Linked to cigarette smoking and alcohol consumption
  – High cure rate
Disorders Involving the Pleura

- Pleurisy
  - Inflammation of pleura
- Pneumothorax
  - Air in pleural space
- Hemothorax
  - Blood in pleural space
Age and the Respiratory Tract

- Tissues lose elasticity, become more rigid
- Decreased compliance, lung capacity
- Increased susceptibility to infection
- Increased incidence of emphysema
- Reduced capacity for exercise
Special Equipment for Respiratory Treatment

- Bronchoscope
- Oxygen therapy
- Suction apparatus
- Tracheostomy tube
- Artificial respiration apparatuses