Organs of the Respiratory System

- Nose, _____, larynx, trachea, _____, lungs—alveoli

Functions of the Respiratory System

- Gas exchanges between the blood and external environment
    - Occurs in the _____ of the lungs
- Passageways to the lungs _____, humidify, and _____ the incoming air

The Nose

- Only externally visible part of the respiratory system
- Air enters the nose through the external nostrils (_____)
- Interior of the nose consists of a nasal cavity divided by a nasal _____

Anatomy of the Nasal Cavity

- _____ receptors are located in the mucosa on the _____ surface
- The rest of the cavity is lined with respiratory mucosa that
    - _____ air
    - _____ incoming foreign particles
- Lateral walls have projections called _____
    - Increase surface area
    - Increase air _____ within the nasal cavity
- The nasal cavity is separated from the oral cavity by the _____
    - Anterior hard palate (_____)
    - Posterior soft palate (_____)

Paranasal Sinuses

- Cavities within bones surrounding the nasal cavity are called _____
- Sinuses are located in the following bones
    - Frontal bone
    - Sphenoid bone
    - _____ bone
    - Maxillary bone
- Function of the sinuses
    - _____ the skull
    - Act as _____ chambers for speech
    - Produce mucus that drains into the nasal cavity

Pharynx (Throat)

- Muscular passage from nasal cavity to _____
- Three regions of the pharynx
    - _____—superior region behind nasal cavity
    - Oropharynx—middle region behind mouth
    - Laryngopharynx—inferior region attached to larynx
- The oropharynx and laryngopharynx are common passageways for _____ and _____

Structures of the Pharynx

- _____ tubes open into the nasopharynx
- Tonsils of the pharynx
    - Pharyngeal tonsil (_____) are located in the nasopharynx
    - Palatine tonsils are located in the oropharynx
    - _____ tonsils are found at the base of the tongue

Larynx (_____)

- Routes air and food into proper channels
- Plays a role in _____
- Made of eight rigid _____ and a spoon-shaped flap of elastic cartilage (_____)

Structures of the Larynx

- Thyroid cartilage
    - _____ of the hyaline cartilages
    - Protrudes anteriorly (_____)
- Epiglottis
    - Protects the superior opening of the _____
    - Routes food to the _____ and air toward the _____
    - When swallowing, the epiglottis rises and forms a _____ over the opening of the larynx
- Vocal folds (true vocal cords)
    - _____ with expelled air to create sound (speech)
- Glottis—_____ between vocal cords

Trachea (Windpipe)

- _____-inch-long tube that connects larynx with bronchi

- Walls are _____ with C-shaped hyaline cartilage
- Lined with ciliated mucosa
    - Beat continuously in the opposite direction of incoming air
    - Expel mucus loaded with _____ and other _____ away from lungs

Main (Primary) Bronchi

- Formed by division of the trachea
- Enters the lung at the _____ (medial depression)
- Right bronchus is _____, shorter, and straighter than left
- Bronchi subdivide into smaller and smaller branches

Lungs

- Occupy most of the _____ cavity
    - Heart occupies central portion called _____
- Apex is near the _____ (superior portion)
- Base rests on the diaphragm (inferior portion)
- Each lung is divided into _____ by fissures
    - Left lung—_____ lobes
    - Right lung—_____ lobes

Coverings of the Lungs

- _____ covers the outer surface of the lungs
    - Pulmonary (_____) pleura covers the lung surface
    - _____ pleura lines the walls of the thoracic cavity
- Pleural _____ fills the area between layers of pleura to allow _____
- These two pleural layers resist being pulled apart

Bronchial (Respiratory) Tree Divisions

- All but the smallest of these passageways have reinforcing _____ in their walls
    - Primary bronchi
    - Secondary bronchi
    - _____ bronchi
    - Bronchioles
    - _____ bronchioles

Respiratory Zone

- Structures
    - Respiratory bronchioles

    - Alveolar _____
    - Alveolar _____
    - Alveoli (air sacs)
- Site of gas exchange = _____ only

Respiratory Membrane (Air-Blood Barrier)

- Thin _____ epithelial layer lines alveolar walls
- Alveolar _____ connect neighboring air sacs
- Pulmonary _____ cover external surfaces of alveoli
- On one side of the membrane is _____ and on the other side is blood flowing past

Gas Exchange

- Gas crosses the respiratory membrane by _____
    - Oxygen enters the _____
    - Carbon dioxide enters the _____
- Alveolar _____ ("dust cells") add protection by picking up _____, carbon particles, and other debris
- _____ (a _____ molecule) coats gas-exposed alveolar surfaces

Four Events of Respiration

- Pulmonary ventilation—moving air in and out of the lungs (commonly called _____)
- External _____—gas exchange between pulmonary blood and alveoli
    - Oxygen is loaded _____ the blood
    - Carbon dioxide is unloaded _____ the blood
- Respiratory gas transport—transport of oxygen and carbon dioxide via the _____
- Internal _____—gas exchange between blood and tissue cells in _____ capillaries

Mechanics of Breathing (Pulmonary Ventilation)

- Completely _____ process that depends on _____ changes in the thoracic cavity
- Volume changes lead to _____ changes, which lead to the flow of _____ to equalize pressure
- Two phases

- _____ = inhalation
  - flow of air into lungs

- _____ = exhalation
  - air leaving lungs

Inspiration

- _____ and external intercostal muscles contract

- The size of the thoracic cavity _____

- External air is _____ into the lungs due to
  - Increase in intrapulmonary volume

  - _____ in gas pressure

Expiration

- Largely a passive process which depends on natural lung _____
- As muscles relax, air is pushed out of the lungs due to
  - Decrease in intrapulmonary volume

  - _____ in gas pressure
- Forced expiration can occur mostly by contracting internal _____ muscles to depress the rib cage

Pressure Differences in the Thoracic Cavity

- Normal pressure within the pleural space is always _____ (intrapleural pressure)

- _____ in lung and pleural space pressures keep lungs from collapsing

Nonrespiratory Air (Gas) Movements

- Can be caused by _____ or voluntary actions
- Examples:
  - Cough and sneeze—clears lungs of _____

  - _____—emotionally induced mechanism
  - Laughing—similar to crying

  - Hiccup—sudden _____
  - Yawn—very deep inspiration

Respiratory Volumes and Capacities

- Normal breathing moves about _____ mL of air with each breath

  - This respiratory volume is _____ volume (TV)
- Many factors that affect respiratory capacity

  - A person's _____
  - Sex
  - Age

- _____ condition

- Inspiratory _____ volume (IRV)
  - Amount of air that can be taken in forcibly _____ the tidal volume
  - Usually between 2100 and 3200 mL
- Expiratory reserve volume (ERV)
  - Amount of air that can be forcibly _____

  - Approximately _____ mL

- _____ volume
  - Air remaining in lung after expiration

  - About _____ ml

- _____ capacity
  - The total amount of exchangeable air
  - Vital capacity = TV + IRV + ERV
  - Dead space volume
    - Air that remains in _____ zone and never reaches alveoli

    - About _____ mL

- Functional volume
  - Air that actually reaches the respiratory zone

  - Usually about _____ mL

- Respiratory capacities are measured with a _____

Respiratory Sounds

- Sounds are monitored with a _____
- Two recognizable sounds can be heard with a stethoscope
    - _____ sounds—produced by air rushing through trachea and bronchi
    - Vesicular breathing sounds—soft sounds of air filling _____

External Respiration

- Oxygen loaded into the blood
    - The alveoli always have _____ oxygen than the blood
    - Oxygen moves by _____ towards the area of lower concentration
    - Pulmonary capillary blood gains oxygen
- Carbon dioxide unloaded out of the blood
    - Blood returning from tissues has _____ concentrations of carbon dioxide than air in the _____
    - Pulmonary capillary blood gives up carbon dioxide to be exhaled
- Blood leaving the lungs is oxygen-_____ and carbon dioxide-_____

Gas Transport in the Blood

- Oxygen transport in the blood
    - Most oxygen attached to _____ to form oxyhemoglobin (HbO_2)
    - A small dissolved amount is carried in the _____
- Carbon dioxide transport in the blood
    - Most is transported in the plasma as _____ ion (HCO_3^-)
    - A small amount is carried inside red blood cells on hemoglobin, but at different binding _____ than those of oxygen
- For carbon dioxide to diffuse out of blood into the alveoli, it must be released from its bicarbonate form:
    - Bicarbonate ions enter _____
    - Combine with hydrogen ions
    - Form carbonic acid (H_2CO_3)
    - Carbonic acid splits to form _____ + CO_2
    - Carbon dioxide diffuses from blood into alveoli

Internal Respiration

- Exchange of gases between blood and body cells
- An opposite reaction to what occurs in the lungs
    - Carbon dioxide diffuses out of _____ to _____ (called *loading*)
    - Oxygen diffuses from _____ into _____ (called *unloading*)

Neural Regulation of Respiration

- Activity of _____ muscles is transmitted to and from the brain by phrenic and intercostal nerves
- Neural centers that control rate and depth are located in the medulla and pons
    - Medulla—sets basic _____ of breathing and contains a pacemaker called the self-exciting inspiratory center
    - Pons—appears to smooth out respiratory rate
- Normal respiratory rate (eupnea)
    - _____ respirations per minute
- Hyperpnea
    - Increased respiratory rate often due to extra _____ needs

Non-Neural Factors Influencing Respiratory Rate and Depth

- Physical factors
    - Increased body temperature
    - _____
    - Talking
    - Coughing
- _____ (conscious control)
- Emotional factors
- Chemical factors: CO_2 levels
    - The body's need to rid itself of CO_2 is the most important _____
    - Increased levels of carbon dioxide (and thus, a decreased or acidic pH) in the blood increase the _____ and _____ of breathing
    - Changes in carbon dioxide act directly on the _____
- Chemical factors: oxygen levels
    - Changes in oxygen concentration in the blood are detected by _____ in the aorta and common carotid artery
    - Information is sent to the medulla

Hyperventilation and Hypoventilation

- Hyperventilation
    - Results from increased _____ in the blood (acidosis)
    - Breathing becomes deeper and more rapid
    - Blows off more CO_2 to restore normal blood ____
- Hypoventilation
    - Results when blood becomes _____ (alkalosis)
    - Extremely slow or shallow breathing
    - Allows CO_2 to accumulate in the blood

Respiratory Disorders: Chronic Obstructive Pulmonary Disease (COPD)

- Exemplified by chronic _____ and emphysema
- Major causes of death and disability in the United States
- Features of these diseases
    - Patients almost always have a history of _____
    - Labored breathing (dyspnea) becomes progressively more severe

- _____ and frequent pulmonary infections are common
- Most victims are hypoxic, retain carbon dioxide, and have respiratory acidosis

- Those infected will ultimately develop respiratory _____

Respiratory Disorders: Chronic Bronchitis

- Mucosa of the lower respiratory passages becomes severely _____

- _____ production increases
- Pooled mucus impairs ventilation and gas exchange
- Risk of lung infection increases

- _____ is common

Respiratory Disorders: Emphysema

- Chronic inflammation promotes lung _____
- Airways collapse during expiration

- Patients use a large amount of _____ to exhale
- Over-inflation of the lungs leads to a permanently expanded _____ chest

Respiratory Disorders: Asthma

- Chronic inflamed hypersensitive bronchiole passages
- Response to irritants with dyspnea, coughing, and wheezing

Respiratory Disorders: Cystic Fibrosis

- A _____ disease that causes an over-secretion of thick mucus that clogs the respiratory system.

Respiratory Disorders: Sudden Infant Death Syndrome (SIDS)

- Apparently healthy infant stops _____ and dies during sleep
- Some cases are thought to be a problem of the neural respiratory control center

- One third of cases appear to be due to _____ rhythm abnormalities
- Recent research shows a genetic component

Respiratory Dissorders: Lung Cancer

- Accounts for _____ of all cancer deaths in the United States
- Increased incidence is associated with smoking
- Three common types

    - _____
    - Adenocarcinoma
    - Small cell carcinoma

Respiratory rate changes throughout life

- Newborns: _____ respirations per minute
- Infants: 30
- Age 5: 25

- Adults: 12 to 18
- Rate often increases somewhat with old age

Aging effects

- _____ of lungs decreases
- Vital capacity decreases

- Blood _____ levels decrease
- Stimulating effects of carbon dioxide decrease

- Elderly are often hypoxic and exhibit sleep _____
- More risks of respiratory tract infection