Respiratory System

Biol 105
Lecture 18
Chapter 14

Outline - Respiratory System
I. Function of the respiratory system
II. Parts of the respiratory system
III. Mechanics of breathing
IV. Regulation of breathing

Respiratory system Function
- The function of the respiratory system is to bring in oxygen to the body and remove carbon dioxide.

The Respiratory System

This type of tissue covers and lines body parts
1. Connective
2. Epithelial
3. Muscle
4. Nervous

Cells lining respiratory tract
- Lined by pseudostratified ciliated columnar epithelial cells. The cilia sweeps mucus, germs and debris toward the throat.
- Mucus produced by goblet cells.
- Smoking damages the ciliated cells

Ciliated cells in respiratory tract
- Cigarette smoke destroys the cilia in airways.
- Smoking damages the ciliated cells

The Respiratory System

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The Respiratory System
1. **Nasal Cavity**

- **Functions:**
  1. Filters the air
  2. Warms the air
  3. Moistens the air entering the lungs
  4. Smell (which also plays a role in the sense of taste)

- **Parts of the nasal cavity:**
  - Mucus membranes - secrete sticky mucus to trap germs & debris.
  - Contains olfactory receptor cells for the sense of smell
  - Sinuses - air-filled cavities, warm and moisten air

2. **Pharynx**

- **Functions:**
  - Is a passageway for air, liquids, and food. (swallowing begins here). Connects the nasal cavity to the esophagus and the larynx
  - Tonsils are found here - lymphatic tissue that protects against infection

3. **Larynx**

- **Functions:**
  1. Connects the pharynx to the trachea
  2. Contains vocal cords used to generate sound
  3. Prevents food from entering the lower respiratory tract

- **Epiglottis closes the trachea when swallowing**
4. Trachea

- Windpipe held open by concentric rings of cartilage
- Function: Connects the larynx to the bronchi.

Bronchial Tree

- Trachea leads to the bronchial tree:
  5. Bronchi (bronchus)
  6. Bronchioles
  7. Alveoli (alveolus)

7. Alveoli

- Sacs at the end of the bronchioles, they are surrounded by blood capillaries.
- Function: It is here that the oxygen diffuses across the membrane into the capillaries, and carbon dioxide goes from the capillaries to the inside of the lungs.

The Respiratory System

Alveoli

- Lungs - have about 300 million alveoli
- The structure of the alveoli increases surface area of lung
- For alveoli to function properly they are coated with phospholipid molecules called surfactant that keep them open

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The Respiratory System

What cells secrete mucus

1. ciliated columnar epi
2. goblet
3. squamous epi
4. osteocytes
The tube connecting the larynx to the primary bronchi is:

1. pharynx
2. trachea
3. bronchioles
4. alveoli

Common passageway for air, food and drink:

1. pharynx
2. trachea
3. bronchioles
4. alveoli

Conducts air from the trachea to the bronchioles:

1. pharynx
2. trachea
3. bronchus
4. alveolus

Gas exchange takes place here:

1. pharynx
2. trachea
3. bronchioles
4. alveoli

Which cavity is the lung located in?

1. abdominal
2. pericardial
3. pleural
4. dorsal

Inhalation:
- When the diaphragm and intercostal muscles contract, the volume of the thoracic cavity increases, causing the pressure in the lungs to decrease.
- Inhalation is also called inspiration.

Exhalation:
- Exhalation = Expiration
- When the same muscles relax, volume of the thoracic cavity decreases, pressure in the lungs increase.
Air Volumes

- The volume of air inhaled or exhaled during a normal breath is called the tidal volume.
- Tidal volume is usually around 500 ml.
- The volume of air moved into and out of the lungs is an indication of health.

Gas Exchanges in the Body

- Remember that O₂ enters and CO₂ leaves the lungs = External respiration.
- Then O₂ and CO₂ is exchanged between the blood vessels and tissues = Internal Respiration.
- This gas exchange is due to diffusion.

Oxygen Transport

- Oxygen is transported on Hemoglobin.
- When Oxygen is bound to hemoglobin, then it is called Oxyhemoglobin.

Carbon Dioxide Transport

1. CO₂ is transported dissolved in the plasma (10%).
2. CO₂ is bound to hemoglobin (20%).
3. CO₂ is converted to bicarbonate ions (70%).

Bicarbonate ions

\[ CO₂ + H₂O \rightarrow H₂CO₃ \rightarrow H⁺ + HCO₃⁻ \]

Diffusion of Gasses: Alveoli and Capillaries

- CO₂ exchanges from blood plasma into alveolar gas.
- O₂, binds to hemoglobin in the red blood cell.
- Capillary network on surface of alveoli.
- O₂ diffuses from alveoli into blood.
- Red blood cell.

Diffusion of Gasses: Capillaries and Tissues

- O₂ diffuses into body cells.
- CO₂ diffuses into blood.
- Internal Respiration: Gas exchange in capillary beds throughout body tissues.
Regulation of Breathing
- Normally we breath 12 - 15 ventilations per minute.
- This rate is controlled by the medulla oblongata region of the brain. Nerves transmit signal to the diaphragm and muscles.
- Chemoreceptors in the medulla oblongata and arteries detect levels of CO₂ and O₂ in the blood, controlling the rate and depth of breathing.

Important Concepts
- Read Ch 15
- What is the function of the respiratory system?
- What is the location and function of all the parts of the respiratory system?
- What are the parts of the nasal cavity and their functions?
- What are the parts of the larynx and their functions?

Important Concepts
- What cell types line the trachea, what are their functions, be able to discuss how smoking effects this tissue?
- Where does the exchange of gases occur in the lungs?
- What cavity contains the lungs?
- What controls the rate of breathing?
- Be able to discuss the mechanics of breathing?

Important Concepts
- How is oxygen carried in the blood?
- How is carbon dioxide carried in the blood, know all the ways, and which is the predominate mode? (You don’t need to know the chemical equation of bicarbonate formation)
- What is the diaphragm and what is its function?

Definitions
- Goblet cells, sinuses, epiglottis, surfactant, diaphragm, intercostal muscles, inhalation/inspiration, exhalation/expiration tidal volume, inspiratory reserve volume, expiratory reserve volume, residual volume, vital capacity, hemoglobin, oxyhemoglobin, chemoreceptors