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Respiratory System

- Respiratory system is an organ system .

Functions of respiratory system

- The functions of respiratory system are:
  - Exchange of gases
  - Oxidation of food
  - The oxidation of food is done inside the tissues.

Purpose of oxidation of food

- Oxidation of food is done to release energy.

Process of respiration

- The process of respiration are divided into:
  - mechanical
  - chemical

Mechanical process of respiration

- There is transport of fresh air.
- The fresh is transported from outside the lungs.
- There is transport of .
- The is transported from lungs to tissues.

- There is transport of .
- The is transported from tissues to lungs.

Chemical process of respiration

- There is release of energy in tissues.
- The energy is released by the oxidation of food.

Types of respiration

The types of respiration are: - Aerobic - Anaerobic

Aerobic Respiration

- Aerobic respiration is done by almost all of the organisms.

Requirement for aerobic respiration

- There is the involvement of oxygen in aerobic respiration.

Location for aerobic respiration:

- Aerobic respiration occurs at:
  - cytoplasm
  - mitochondria

Amount of energy in aerobic respiration

- There is the release of large amount of energy in aerobic respiration.

Quantity in aerobic motion

- The reactant is glucose.
- The products are ATP molecules.
- 1 molecule of glucose releases 38 ATP molecules.

Chemical expression for aerobic respiration:

$$C_6H_{12}O_6 + O_2 \longrightarrow CO_2 + H_2O + \text{Energy}$$

Anaerobic Respiration

Requirement of Anaerobic respiration

- Anaerobic respiration occurs in the presence of certain enzymes.

Organisms conducting aerobic respiration:

- The organisms conducting aerobic respiration are:
  - Taniea
  - Ascaris
  - Bacteria
  - Fruits
  - Germinating seeds
  - Yeast

Limitation of Anaerobic respiration in terms of process

- Anaerobic respiration is such where oxygen is not required.

Quantity of Anaerobic Respiration

- The reactant in Anaerobic respiration is glucose.
- The product in anaerobic respiration is ATP molecules.
- One molecule of glucose yields 2 ATP molecules.

Equation for Anaerobic respiration

- The equation for anaerobic respiration is expressed as:

$$\mathrm{C_6H_{12}O_6} \longrightarrow \mathrm{C_3H_6O_3} + \mathrm{Energy}$$

$$\mathrm{C_6H_{12}O_6} \longrightarrow \mathrm{C_2H_5OH} + \mathrm{CO_2} + \mathrm{Energy}$$

Feature of aerobic respiration in muscles

- Striped Muscles can do anaerobic respiration.
- The anaerobic respiration can be done in the absence of oxygen.
- Oxygen may be absent in emergency condition.
- The other name for striped muscles is skeletal muscles.

Respiratory organs

- The respiratory organs are
  - Nose and nasal chamber
  - Pharynx
  - Larynx
  - Trachea
  - Bronchi
  - Lungs
  - Respiratory muscles

Nose and nasal chamber

Background

Shape of nose

- Nose is a triangular structure.

Backbone of nose

- Nose is made up of muscles

Supportive structure of nose

- Nose is supported by
  - bones
  - cartilage

Anatomy of Nose

- The parts of nose are:
  - external nostrils
  - nasal chamber
  - internal nostrils

External nostrils

- External nostrils are paired apertures.

Location of external nostrils

- External nostrils open outside the nose.

Nasal chamber

Types of nasal chamber

- The types of nasal chamber are:
  - left nasal chamber
  - right nasal chamber

Division of nasal chamber

- The division of nasal chamber is done by a septum.
- The arrangement of the septum that divides the nasal chamber is vertical.

Histology of nasal chamber

- Nasal chamber is lined internally by ciliated epithelium.

Nasal conchae

- The another term for nasal conchae is nasal turbinates.

Location of nasal conchae

- Nasal conchae are present in the respiratory region of nasal chamber

Shape of nasal conchae

- The shape of nasal conchae is that of a convoluted scroll.

Quantity of nasal conchae

- There are three pairs of nasal conchae present at the respiratory region of nasal chamber.

Material structure of nasal conchae

- Nasal conchae are bony projections.

Paranasal sinuses

Anatomy of paranasal sinuses

- Paranasal sinuses are air filled cavity.

Types of paranasal sinuses

- The types of paranasal sinuses are
  - frontal
  - ethmoidal
  - maxillary
  - sphenoid

Hisology of paranasal sinuses

- Paranasal sinuses are lined by mucus cells.

Internal nostrils

- location of internal nostrils
- internal nostrils open inside the pharynx.

Functions of nose

- Nose prevents the entrance of dust into the lungs.
- Nose makes the air moist and warm.
- Nose detects the smell by olfactory receptors.

Role of vibrissae

- The other term for vibrissae is nasal hairs.
- Nasal hairs trap
  - dust particles
  - microorganism
- This is done with the help of mucus.

Pharynx

Types of pharynx

- The types of pharynx are
  - nasopharynx
  - oropharynx
  - laryngopharynx

Role of nasopharynx

- Nasopharynx leads to eustachian tube

Role of Laryngopharynx

- Laryngopharynx leads to larynx.
  - This is done through an opening.
  - The opening is called epiglottis.

Function of pharynx

- Pharynx passes food.
- Pharynx passes air.

Larynx

Anatomy of larynx

- larynx is a hollow cartiligionous box.

Location of larynx

- Larynx is located at
  - the top of trachea
  - the range of the location is from (c_{3})to (c_{6})

Composition of larynx

- Larynx is made up of cartilages.
- The number of cartilages that make up the larynx are 9.
- The types of cartilages are single and paired.
- The single cartilages making the larynx are:
  - thryroid cartilage
  - circoid cartilage
  - epiglottis
- Each cartilage in pair cartilage consitutues for a quantity of cartilage.
- The types of paired cartilage are
  - arytenoid
  - corniculate
  - cuneiform

Largest cartilage in larynx

- The largest cartilage in the larynx is the thyroid cartilage.
- Thyroid cartilage gets enlarged in male.

- This enlargement is the result of puberty.
- The enlargement of thyroid is coordinated by a hormone.
- The hormone responsible for enlargement of thyroid cartilage is testosterone.

Epiglottis

Structure of epiglottis

- Epiglottis is a leaf like structure.

Composition of epiglottis

- Epiglottis is made up of fibro elastic cartilage.

Role of epiglottis

- Epiglottis close the glottis.
- The closing of glottis by the epiglottis is done during sallowing.

Vocal cords

Location of vocal cords

- Vocal cords are present among
  - thyroid cartilage
  - arytenoid cartilage

Types of vocal cords

- There are two types of vocal cords
  - Superior pair
  - Inferior pair

Superior Pair

- Superior pair is a false vocal cord.
  - This is because superior pair have no role in producing sound

Inferior Pair

- Inferior pair is true vocal cord.
  - This is because inferior pair have the main role in producing sound.

Mechanism of production of sound

- The sound is produced by the passage of air.
- The air passes through the true vocal cord.
- Sound is produced by the vibration of true vocal cord.

Trachea

Anatomy of trachea

- Trachea is a hollow tube.

Location of trachea

- Trachea is located from
  - larynx
  - upper part of thoracic cavity
- The range for the location of trachea are
  - (c_{6}) to (t_{5})
- Trachea lies in parallel to oesophagus.
- Trachea lies in ventral to oesophagus.

Dimesnsions of trachea

Length of trachea

- The length of is :
  - (12cm)

Diameter of trachea

- The diameter of trachea is:
  - (2.5cm)

Histological structure of trachea

- There is the presence of internal lining in trachea.
- The internal lining is done by pseudo stratified epithelium.
- The pseudo stratified epithelium have the presence of goblet cell.

Anatomical structure of trachea

Contents of tracheal rings

- Tracheal rings are made up of cartiliginous rings.
- The cartiliginous rings are c shaped.
- The cartiliginous rings are incomplete.

Function of tracheal rings

- The functions of tracheal rings are:
  - Tracheal rings prevent the collapsing of trachea.
  - The prevention of collapsing of trachea is done during breathing.

Bronchi and Bronchioles

Types of bronchus

- The trachea divides into:
  - right bronchus
  - left bronchus
- The division occurs at (t_{5})

Structure of right bronchus

- Right bronchus is shorter.
- Right bronchus is wider.
- The length of right bronchus is (2.5cm).

Structural arrangement of right bronchus

- Right bronchus divides into 3 branches.
- Each branch of right bronchus passes into each lobes of the lungs.

Structure of left bronchus

- Left bronchus is longer.
- Left bronchus is narrower.
- The length of left bronchus is (5cm).

Structural arrangement of left bronchus

- Left bronchus is divided into (2)branches.
- Each branch of the left bronchus passes into the respective lobe.

Division of lobular branches

- The division of lobular branches occur in the order of:
  - tertiary branches
  - bronchioles
  - terminal bronchioles
  - respiratory bonchioles
  - alvelolar duct
  - alveoli

Anatomy of bronchi

- Bronchi are supported by cartiliginious rings.
- The cartiliginous rings are incomplete.

Histology of bronchi

- Bronchi are lined by pseudo stratified epithelium.

Histology of bronchioles

- Bronchioles are line by two types of tissues.
- The two types of tissues that line the bronchioles are
  - ciliated columnar
  - cuboidal epithelium

Lungs and Alveoli

Lungs

- There is a pair of lungs present at the human body.
- The shape of the lungs is conical.

  - Lung has a basal part.
  - Lung has an apical part.
- The material nature of lungs is soft.
- The lungs are spongy.

Basal part of lung

- The basal part of lung in broad.
- The basal part of lung is concave.

Location of basal part of the lung

- The basal part of the lung rests on the diaphgram.

Apical part of lung

- The apical part of the lungs is narrower.

Appearance of lungs

- The lungs are pinkish in nature.

Location of lungs

- The lungs are present at the either side of the heart.
- The lungs occupy the greater region of the thoracic cavity.

Outer Histology of lung

- The lung is enclosed in a double layered membrane.
- The double layered membrane in which the lungs is enclosed is called pleura.

Description of double layered membrane of lung

Outer membrane

- The outer membrane of the lung is parietal membrane.i

Role of parietal membrane

- The parietal membrane encloses the pleural space.

Inner membrane

- The inner membrane of the lung is the visceral membrane.

Left lung

- Left lung is smaller.
- Left lung has cardiac notch.

Right lung

- Right lung is bigger.

Lobes of right lung

- The right lung has three lobes.
- The lobes of the right lung are marked by fissures.

Lobes of left lung

- The left lung has two lobes.
- The lobes of the left lung are marked by fissures.

Internal structure of the lungs

- The internal structure of lungs is structured as:
  - tree of bronchi
  - bronchioles
  - alveoli

Alveoli

- The anatomical structure of alveoli is a
  - sac
- The alveoli are richly vascularized.

Quantity of alveoli

- The quantity of alveoli present in the lungs are (300 million.)

Anatomy of alveoli

- The wall of alveoli consists of two types of cells.
  - Type I pneumocytes
  - Type II pnuemocytes

Role of Type I pneumocytes

- Type I pneumocytes exchange gases.

Role Type II penumocytes

- Type II peumocytes produce surfactant.

Role of surfactant in alveoli

- There is the presence of surfactant in alveoli.
- Surfactant is a compostion of:
  - phospholipid
  - protein
- The surfactant reduce tension in alveoli.
- The surfactant prevent alveolar collapse during expiration.

Arteries of lungs

- There are two arteries present in the lungs.
- The arteries present in the lungs are:
  - pulmonary artery
  - bronchial artery

Role of pulmonary artery in lungs

- The role of pulmonary artery is to provide deoxygenated blood to the lungs.

Role of bronchial artery in lungs

- The role of bronchial artery is to provide oxygenated blood in the lungs.

Respiratory muscles

Types of respiratory muscles

- The types of respiratory muscles are:
  - Main muscles
  - Accessory muscles

Types of main muscles

- The types of main muscles are:
  - Diaphgram
  - Intercostal muscles

Structure of diaphgram

- The diaphgram is a thin structure.
- The diaphgram is a muscular structure.

Role of diphgram in anatomy

- Diaphgram separates two cavities.
- The cavities that diaphgram separates are:
  - thoracic
  - abdominal

Role of diaphgram in respiration

- Diaphgram lowers down during contraction.
- Diaphgram exhibits the following characters in contraction:
  - Diaphgram becomes flat.
  - Diaphgram becomes straight.

Location of intercostal muscles

- Intercostal muscles are present :
  - in between the ribs.

Types of intercostal muscles

- The intercostal muscles are categorized in terms of their arrangement.
- The types of intercostal muscles in the basis of their arrangement are:
  - external intercostal muscles
  - internal intercostal muscles

Physiology of respiration

- The physiology of respiration consists of the following steps:
  1. Breathing
  2. Exchange of gases
  3. Transport of Oxygen
  4. Internal Respiration
  5. Transport of Carbon dioxide

Breathing

- Breathing is the process of :
  - inhalation of oxygen from external environment to the lungs.
  - exhalation of carbon dioxide from lungs to the external environment

Steps of breathing

- The steps of breathing are:
  - Inspiration
  - Expiration

Rate of breathing

- The normal breathing rate is:
  - (12-16) times per minute

Inspiration

- Inspiration is the process of intake of from external environment to the lungs.

Condition for inspiration

- Inspiration occurs when pulmonary air pressure is lower than atmospheric pressure.

Process of inspiration

External Intercostal Muscles

- External intercostal muscles contract.
- External intercostal muscles are pulled outward .
- External intercostal muscles are pulled upward.

Diaphgram

- Muscles of diaphgram contract.
- Muscles of diaphgram becomes wide.
- Muscles of diaphgram becomes straight.

Thoracic Cavity

- The size of thoracic cavity increases.
  - The increase in size of thoracic cavity expands the lungs.

Prepost Inspiration

- The air pressure decreases in the lungs.
  - The air pressure decreases in the lungs due to increase in volume of the lungs.
- The air from atmosphere rushes towards the lungs.
  - The air from atmosphere rushes towards the lungs to maintain
    - inner air pressure
    - outer atmospheric pressure

Expiration

- Expiration is the process of exhaling from lungs.
- gas is exhaled in expiration.
- The exhalation occurs from the lungs to the external environment.

Condition for expiration

- Expiration occurs when intra pulmonary air pressure is more than atmospheric pressure.

Process of Expiration

Internal Intercostal Muscles

- Internal intercostal muscles contract.
  - Contraction of internal intercostal muscles moves ribs inward.
  - Contraction of internal intercostal muscles moves ribs downward.

Diaphgram

- The relaxation of diaphgram occurs.
- Diaphgram moves to it's original position.
- The original shape of diaphgram is dome shape.

Thoracic cavity

- Size of thoracic cavity decreases.
  - The decrease in size of thoracic cavity decreases the volume of the lungs.

Prepost expiration

- There is increase of air pressure in the lungs.
  - The increase in air pressure of the lungs pushes the air form lungs to the external environment.

Exchange of gases in the lungs

- Oxygen comes down to the alveolar surface.
- Blood comes up to the alveolar surface.
- The alveolar membrane is extremely thin.
- There is close contact of air and blood.

Diffusion Membrane

- The diffusion membrane of alveoli is made up of layers.
- The layers that make up the diffusion membrane are three in number.

Layers of diffusion membrane

- The layers of diffusion membrane are:
  - Squamous Epithelium
    - The squamous epithelium is that of the alveoli.
  - Endothelium
    - Endothelium is that of the alveolar capillaries.
  - Basement substance

* Basement substance is present between squamous epithelium and endothelium.

Method of exchange of gases in lungs

- Exchange in gases of lungs occurs by:
  - simple diffusion method.

Mechanism of exchange of gases in lungs

- Diffusion of gases occurs along the concentration gradient.
  - Diffusion of gases occurs from higher partial pressure to lower partial pressure.

Pressure in venous blood

- Venous blood has lower partial pressure of oxygen.
- Venous blood has higher partial pressure of carbon dioxide.

Magnitude of pressure in venous blood

- The magnitude of partial pressure of oxygen in venous blood is:
  - (P() = 40mm Hg)
- The magnitude of partial pressure of carbon dioxide in venous blood is:
  - (P() = 44mm Hg)

Pressure in alveolar air

- Alveolar air has higher partial pressure of oxygen.
- Alveolar air has lower partial pressure of carbon dioxide.

Magnitude of pressure in alveolar air

- The magnitude of partial pressure of oxygen in alveolar air is:
  - (P() = 100 mm Hg)
- The magnitude of partial pressure of carbon dioxide in alveolar air is:
  - (P() = 40 mm Hg)

Process of diffusion in alveoli

- diffuses from the alveolar air to the blood capillaries.
- diffuses from the blood capillaries into the alveolar air.

Transport of oxygen

Medium for transport of oxygen

- Oxygen is transported by blood.
- Blood transports oxygen from lungs to tissues.

Quantity of oxygen in blood

- (100ml _) of arterial blood can carry (20ml)of oxygen.

Transport in the form of solution

- Oxygen dissolves in the plasma of the blood.
- The quantity of oxygen that dissolves in the plasma of the blood is:
  - (1-3 %)

Transport of oxygen in the form of oxyhaemoglobin

Amount of oxygen in oxyhaemoglobin

- The quantity of oxygen transported in the form of oxyhaemoglobin is:
  - (97-99 %)

Process of formation of oxyhaemoglobin

- The reactants in the formation of oxyhaemoglobin are:
  - Oxygen
  - Haemoglobin
- Oxygen combines with haemoglobin of red blood cells.
- The combination of oxygen and haemoglobin forms oxyhaemoglobin.

Chemical equation for the formation of oxyhaemoglobin

$$\mathrm{Hb} + 4\,\mathrm{O_2} \longrightarrow \mathrm{Hb} \cdot (4\,\mathrm{O_2})$$

Condition for formation of oxyhaemoglobin

- The conditions for the formation of oxyhaemoglobin are:
  - There is the decrement of partial pressure of .
  - There is the decrement of temperature.
  - There is the presence of high blood (pH) in lungs.

Nature of oxyhaemoglobin

- Oxyhaemoglobin is unstable compound.

Disassociation of oxyhaemoglobin

- Oxyhaemoglobin disassociates to release .
- The disassociation of oxyhaemoglobin occurs in certain conditions.

Quantity of oxygen in haemoglobin

- One molecule of can carry (4) molecules of oxygen.

Internal Respiration

Steps in internal respiration

- The steps in internal respiration are:
  - disassociation of oxyhaemoglobin
  - oxidation of food

Disassociation of oxyhaemoglobin

Condition for disassociation of oxyhaemoglobin

- The conditions for disassociation of oxyhaemoglobin are:
  - There is the presence of high partial pressure of .
  - There is the presence of high temperature.

Chemical equation for disassociation of oxyhaemoglobin

$$\mathrm{Hb}(4\,\mathrm{O_2}) \longrightarrow \mathrm{Hb} + 4\,\mathrm{O_2}$$

Oxidation of Food

- There is the breakdown of glucose.
- The breakdown of glucose yields:
  - carbon dioxide
  - energy
  - water

Equation for oxidation of food

$$C_6H_{12}O_6 + O_2 \longrightarrow 6\,CO_2 + 6\,H_{20} + \text{Energy}$$

Requirement for oxidation of food

- Oxygen is needed for the oxidation of food.

Transport of carbon dioxide

Need for expulsion of carbon dioxide

- Carbon dioxide should be expulsed out of the body.
- The need for the expulsion of carbon dioxide is because:
  - Carbon dioxide is toxic to the body.

Transport of carbon dioxide as carbonic acid

Amount of carbon dioxide transported as carbonic acid.

- The amount of carbon dioxide transported as carbon dioxide is:
  - (7 %)

Process of formation of carbonic acid

- The reactants for the formation of carbonic acid are:
  - carbon dioxide
  - water
- Carbon dioxide reacts with water to form carbonic acid.

Chemical equation for formation of carbonic acid

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

Transport of carbon dioxide as bicarbonates

Amount of carbon dioxide transferred as bicarbonates

- The amount of carbon dioxide transported by bicarbonates is:
  - (7%)

Pre Process of formation of bicarbonates

- Carbon dioxide diffuses to red blood cells.
- Carbon dioxide reacts with water.
- The product from the reaction of carbon dioxide and water is carbonic acid.

Condition for the formation of Carbonic acid

- Carbonic acid only forms in the presence of :
  - carbonic anhydrase

Nature of carbonic acid

- Carbonic acid is unstable.
- Carbonic acid disassociates due to it's unstability.
- The dissociation of carbonic acid results the formation of:
  -
  -

Chloride shift

- The other name for chloride shift is hamburger phenomena.
- The diffusion of chloride ions from plasma to red blood cells is called chloride shift.

Purpose of chloride shift

- Chloride shift occurs for the need to maintain ionic balance.

Process of formation of bicarbonates

- Bicarbonate ions diffuse into the plasma.
- Bicarbonate ions diffuse into the plasma from RBC.
- Bicarbonate ions form metallic bicarbonate by combining either with:
  -
  -

Chemical equations for the formation of bicarbonates

$$\mathrm{CO_2 + H_2O \xrightarrow{carbonic\ anhydrase} H_2CO_3 \longleftrightarrow H+ + HCO3-}$$
$$\mathrm{K+ + HCO3- \longrightarrow KHCO_3}$$
$$\mathrm{Na+ + HCO3- \longrightarrow NaHCO_3}$$

Transport of carbon dioxide as carbamino compound

Amount of carbamino compound

- The amount of carbon dioxide transported in the form of carbamino compounds is:
  - (23%)

Process of formation of carbamino compound

Reactants in the formation of carbamino compound

- The reactants for the formation of carbamino compound are:
  - carbon dioxide
  - amnio group of haemoglobin
- Carbon dioxide reacts with amino group of haemoglobin to form carbamino haemoglobin compound.

Chemical equation for formation of carbamino compound

$$\mathrm{CO_2 + Hb \cdot NH_2 \longrightarrow HbNHCOOH}$$

Bohr's effect

- Bohr's effect is the effect of CO_2 concentration on disassociation of oxyhaemoglobin.

Discovery

- Bohr's effect was discovered by
  - Christian Bohr

High Partial Pressure of Carbon Dioxide

- High partial pressure of carbon dioxide enhances the
  - disassociation of oxyhaemoglobin

Low Partial Pressure of Carbon Dioxide

- Low partial pressure of carbon dioxide enhances the
  - formation of oxyhaemoglobin

Bohr's Curve

- The other name for Bohr's curve is
  - oxygen disasscociation curev

Graph of Bohr's Curve

- Bohr's curve is plotted among
  - percentage saturation of haemoglobin with oxygen
  - partial pressure of oxygen
- The nature of Bohr's curve is
  - sigmoid

Analysis of Bohr's curve

Increment of partial pressure of carbon dioxide

- The curve moves downward towards the right.
- The percentage of saturation of haemoglobin with oxygen decreases.

Decrement of partial pressure of carbon dioxide

- The percentage of saturation of haemoglobin with oxygen increases.

Factors affecting affinity of haemoglobin and oxygen

Increment of Temperature

- The affinity of haemoglobin with oxygen **decreases** in *rise in temperature*.
- The percentage saturation of haemoglobin with oxygen decreases with increase in temperature.

Decrement of Temperature

- The affinity of haemoglobin with oxygen **increases** in *fall in temperature*.
- The percentage saturation of haemoglobin with oxygen increases with decrease in temperature.

Increment of pH

- The affinity of haemoglobin with oxygen **increases** with *rise in pH* .
- The percentage saturation of haemoglobin with oxygen increases with rise in pH.

Decrement of pH

- The affinity of haemoglobin with oxygen **decreases** with *fall in pH* .
- The percentage saturation of haemoglobin with oxygen decreases with fall in pH.

Terms related to respiration

Spirometry

- Spirometry is the process of evaluating
  - pulmonary volumes
  - pulmonary capacities

Tidal volume

- Tidal volume is the amount of air exchanged during normal breathing.
- The magnitude of tidal volume is
  - 500ml

Inspiratory Reserve Volume

- The short form for inspiratory reserve volume is
  - IRV
- Inspiratory Reserve Volume is the additional volume of air, a person can inspire by forceful inspiration.
- The magnitude of inspiratory reserve volume is
  - 3000 ml

Expiratory Reserve Volume

- The short form for expiratory reserve volume is
  - ERV
- Expiratory reserve volume is the additional volume of air, a person can expire by forceful expiration.
- The magnitude of expiratory reserve volume is
  - 1100 ml