



NCERT Solutions for 11th Class Biology: Chapter 17-Breathing and exchange of gases



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Class 11: Biology Chapter 17 solutions. Complete Class 11 Biology Chapter 17 Notes.

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Exercises

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1. Define vital capacity. What is its significance?**Answer**

The maximum volume of air a person can breathe in after a forced expiration is called vital capacity. It helps in finding differentiate causes of lung disease.

2. State the volume of air remaining in the lungs after a normal breathing.**Answer**

The volume of air remaining in the lungs after a normal breathing is called Functional residual capacity (FRC). This includes expiratory reserve volume (ERV) and residual volume (RV). ERV=1000 to 1100 ml

RV = 1100 to 1200 ml

Thus, FRC = 2100 to 2300 ml

3. Diffusion of gases occurs in the alveolar region only and not in the other parts of respiratory system. Why?**Answer**

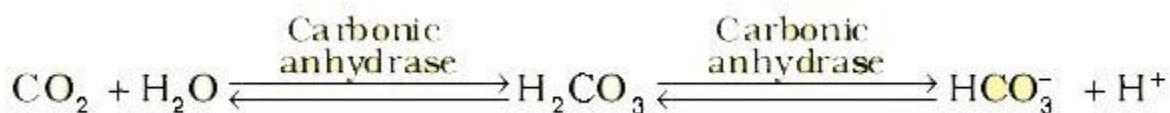
Alveoli are the primary sites of exchange of gases. Exchange of gases also occur between blood and tissues. O_2 and CO_2 are exchanged in these sites by simple diffusion mainly based on pressure/concentration gradient. Alveolar region is having enough pressure gradient to facilitate diffusion of gases while other regions of the respiratory system don't have the required pressure gradient. Solubility of the gases as well as the thickness of the membranes involved in diffusion are also some important factors that can affect the rate of diffusion.

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4. What are the major transport mechanisms for CO₂? Explain.

Answer

CO₂ is carried by haemoglobin as carbamino-haemoglobin (about 20-25 per cent). This binding is related to the partial pressure of CO₂. pO₂ is a major factor which could affect this binding. When pCO₂ is high and pO₂ is low as in the tissues, more binding of carbon dioxide occurs whereas, when the pCO₂ is low and pO₂ is high as in the alveoli, dissociation of CO₂ from carbamino-haemoglobin takes place, i.e., CO₂ which is bound to haemoglobin from the tissues is delivered at the alveoli. RBCs contain a very high concentration of the enzyme, carbonic anhydrase and minute quantities of the same is present in the plasma too. This enzyme facilitates the following reaction in both directions.



At the tissue site where partial pressure of CO₂ is high due to catabolism, CO₂ diffuses into blood (RBCs and plasma) and forms HCO₃⁻ and H⁺. At the alveolar site where pCO₂ is low, the reaction proceeds in the opposite direction leading to the formation of CO₂ and H₂O. Thus, CO₂ trapped as bicarbonate at the tissue level and transported to the alveoli is released out as CO₂ as shown in above figure. Every 100 ml of deoxygenated blood delivers approximately 4 ml of CO₂ to the alveoli.

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5. What will be the pO₂ and pCO₂ in the atmospheric air compared to those in the alveolar air?

(i) pO₂ lesser, pCO₂ higher

(ii) pO₂ higher, pCO₂ lesser

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(iii) pO_2 higher, pCO_2 higher

(iv) pO_2 lesser, pCO_2 lesser

Answer

(ii) pO_2 higher, pCO_2 lesser

6. Explain the process of inspiration under normal conditions.

Answer

Inspiration is initiated by the contraction of diaphragm which increases the volume of thoracic chamber in the antero-posterior axis. The contraction of external inter-costal muscles lifts up the ribs and the sternum causing an increase in the volume of the thoracic chamber in the dorso-ventral axis. The overall increase in the thoracic volume causes a similar increase in pulmonary volume. An increase in pulmonary volume decreases the intra-pulmonary pressure to less than the atmospheric pressure. This pressure gradient forces the air from outside to move into the lungs and inspiration takes place.

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7. How is respiration regulated?

Answer

The respiration is regulated by neural system. A specialised centre present in the medulla region of the brain called respiratory rhythm centre is primarily responsible for this regulation. Another centre present in the pons region of the brain called pneumotaxic centre can moderate the functions of the respiratory rhythm centre. Neural signal from this centre can reduce the duration of inspiration and thereby alter the respiratory rate. A chemosensitive area is situated adjacent to the rhythm centre which is highly sensitive to CO_2 and hydrogen ions. Increase in these substances

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can activate this centre, which in turn can signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated. Receptors associated with aortic arch and carotid artery also can recognise changes in CO_2 and H^+ concentration and send necessary signals to the rhythm centre for remedial actions. The role of oxygen in the regulation of respiratory rhythm is quite insignificant.

8. What is the effect of pCO_2 on oxygen transport?

Answer

pCO_2 plays a major role in transportation of oxygen. In the alveoli, the low pCO_2 and high pO_2 favours the formation of haemoglobin. In the tissues, the high pCO_2 and low pO_2 favours the dissociation of oxygen from oxyhaemoglobin. Hence, the affinity of haemoglobin for oxygen is enhanced by the decrease of pCO_2 in blood. Therefore, oxygen is transported in blood as oxyhaemoglobin and oxygen dissociates from it at the tissues.

9. What happens to the respiratory process in a man going up a hill?

Answer

When a man going up a hill he has to exert more effort to climb which increases the consumption of oxygen. As a result, the partial pressure of oxygen in haemoglobin decreases which creates more demand for oxygen. Thus, the breathing rate increases to fill this gap.

10. What is the site of gaseous exchange in an insect?

Answer

Insects have a network of tubes known as tracheal tubes to transport atmospheric air within the body. The tracheae open on the lateral surface of the animal through minute pores called spiracles.

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11. Define oxygen dissociation curve. Can you suggest any reason for its sigmoidal pattern?

Answer

When percentage saturation of haemoglobin with O_2 is plotted against the pO_2 a sigmoid curve is obtained which is called Oxygen dissociation curve.

The dissociation curve is sigmoidal pattern because of the binding of oxygen to haemoglobin. As the first oxygen molecule binds to haemoglobin, it increases the affinity for the second molecule of oxygen to bind. Subsequently, haemoglobin attracts more oxygen.

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12. Have you heard about hypoxia? Try to gather information about it, and discuss with your friends.

Answer

Hypoxia is defined as a condition of the body in which the tissue have shortage of oxygen. It generally happens because of a mismatch between oxygen demand and supply.

13. Distinguish between

(a) IRV and ERV

(b) Inspiratory capacity and Expiratory capacity

(c) Vital capacity and Total lung capacity

Answer

(a) IRV and ERV

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Inspiratory reserve volume (IRV)

It is the maximum volume of air that can be inhaled after a normal inspiration.

It is about 2500-3500 mL in the human lungs.

Expiratory reserve volume (ERV)

It is the maximum volume of air that can be exhaled after a normal expiration.

It is about 1000-1100 mL in the human lungs.

(b) Inspiratory capacity and Expiratory capacity**Inspiratory capacity (IC)**

It is the volume of air that can be inhaled after a normal expiration.

It includes tidal volume and inspiratory reserve volume.
(IC = TV + IRV)

Expiratory capacity (EC)

It is the volume of air that can be exhaled after a normal inspiration.

It includes tidal volume and expiratory reserve volume.
(EC = TV + ERV)

(c) Vital capacity and Total lung capacity**Vital capacity (VC)**

It is the maximum volume of air that can be exhaled after a maximum inspiration.

Total lung capacity (TLC)

It is the volume of air in the lungs after maximum inspiration. It includes IC, ERV, and residual volume.

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It includes IC and ERV

It includes IC, ERV, and residual volume.

It is about 4000 mL in the human lungs.

It is about 5000-6000 mL in the human lungs.

14. What is Tidal volume? Find out the Tidal volume (approximate value) for a healthy human in an hour.

Answer

Tidal volume is the volume of air inspired or expired during normal respiration. It is approximately 500 ml in a healthy man.

The hourly tidal volume for a healthy human (taking 12 breathes/min) can be calculated as:

$$= 500 \text{ ml} \times 12 \times 60 \text{ minute} = 360000 \text{ ml}$$

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- Chapter 1: The Living World
- Chapter 2: Biological Classification
- Chapter 3: Plant Kingdom
- Chapter 4: Animal Kingdom
- Chapter 5: Morphology of Flowering Plants
- Chapter 6: Anatomy of Flowering Plants
- Chapter 7: Structural Organisation in Animals
- Chapter 8: Cell-The Unit of Life
- Chapter 9: Biomolecules
- Chapter 10: Cell Cycle and Cell Division
- Chapter 11: Transport in Plants
- Chapter 12: Mineral Nutrition
- Chapter 13: Photosynthesis in Higher Plants
- Chapter 14: Respiration in Plants
- Chapter 15: Plant - Growth and Development
- Chapter 16: Digestion and Absorption
- Chapter 17: Breathing and Exchange of Gases
- Chapter 18: Body Fluids and Circulation
- Chapter 19: Excretory Products and Their Elimination
- Chapter 20: Locomotion and Movement
- Chapter 21: Neural Control and Coordination
- Chapter 22: Chemical Coordination and Integration

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