**B6 - RESPIRATION**

**6.1 - Aerobic and anaerobic respiration**

**1. Define respiration**

The chemical reactions that break down nutrient molecules in living cells to release energy.

**2. State the uses of energy in the body of humans:**

* Muscle contraction;
* Protein synthesis;
* Cell division;
* Growth;
* The passage of nerve impulses;
* Maintenance of a constant body temperature.

**3. State the word equation for aerobic respiration.**

**5. State the symbol equation for aerobic respiration.**

Glucose + Oxygen Carbon dioxide + Water

C6H12O6  + 6O2 6CO2 + 6H2O

**4. Define aerobic respiration**

The release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of oxygen.

**6. Define aerobic respiration**

The release of a relatively small amount of energy by the breakdown of food substances in the absence of oxygen.

**7. State the word equation for anaerobic respiration in muscles during hard exercise and in yeast.**

 In muscles: Glucose Lactic acid

 In microorganism yeast: Glucose Alcohol + Carbon dioxide

**8. Describe the effect of lactic acid in muscles during exercise (include oxygen debt - outline only)**

 > When exercising vigorously, the blood cannot supply enough oxygen to the muscles for aerobic respiration

 > Therefore the muscles respire anaerobically;

 > Lactic acid builds up in the muscles and causes cramp;

 > The liver breaks down lactic acid with oxygen;

 > When you stop exercising, you go on breathing hard to get oxygen to break down the lactic acid;

 > This is called an *oxygen debt* because during vigorous exercise you ‘borrowed’ some extra energy, without

 ‘paying’ for it with oxygen;

 > When all the lactic acid has been broken down, your breathing rate & rate of heart beat return to normal.

**9. Describe the role of anaerobic respiration in yeast during brewing and bread-making.**

*Brewing*

* To make beer, yeast is dissolved in a warm liquid containing the sugar maltose;
* The yeast respires anaerobically by a process called fermentation;
* This process produces ethyl alcohol (ethanol) making the drink alcoholic;
* and carbon dioxide which makes the drink fizzy.

*Bread making*

* Yeast is mixed with water and sugar to activate it;
* The mixture is added to flour to make dough, and left in a warm place;
* The dough rises as the yeast respires and releases carbon dioxide, which gets trapped in the dough;
* When the dough is cooked, the high temperature kills the yeast and evaporates any alcohol formed;
* Air spaces are left where the carbon dioxide was trapped, which gives the bread a light texture.

 **10. Compare aerobic respiration and anaerobic respiration in terms of relative amounts of energy released.**

|  |  |
| --- | --- |
| *Aerobic respiration* | *Anaerobic respiration* |
| Uses oxygen | Does not use oxygen |
| No alcohol or lactic acid made | Alcohol (in yeast and plants) or lactic acid (in animals) is made |
| Large amount of energy released from each molecule of glucose | Much less energy released from each molecule of glucose |
| Carbon dioxide made | Carbon dioxide is made by yeast and plants, but not by animals |

**6.2 Gas Exchange**

1. **Identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries.**





1. **List the features of gas exchange surfaces in animals.**
* Wall of the alveolus is thin (a single layer of cells) to allow gases to diffuse across them quickly;
* They are moist to prevent the cells from drying and to allow gases to dissolve;
* They have a large surface area , so that a lot of gas can diffuse across at the same time;
* They have a high concentration gradient - maintained by the movement of air & blood.
1. **Explain the role of mucus and cilia in protecting the gas exchange system from pathogens and particles.**

 **Air**

**Diagram of lining of trachea**

* The lining contains two kinds of cells: Goblet cells and ciliated cells;
* Goblet cells make sticky, slimy mucus;
* Many of the bacteria in the air and dust particles get trapped in the mucus;
* Ciliated cells have tiny, microscopic hair on them called cilia;
* The cilia beat in unison, and sweep the mucus upwards, towards the back of the throat.
1. **Describe the effects of tobacco smoke and its major toxic components (tar, nicotine, carbon monoxide, smoke particles) on the gas exchange system.**

|  |  |
| --- | --- |
| Chemical | Effects on gas exchange system |
| Carbon monoxide | A poisonous gas; combines with hemoglobin in RBC, preventing them from transporting oxygen |
| Nicotine | Addictive; increases heart rate & blood pressure |
| Smoke particles | Irritate the air passages, causing inflammation & increased mucus production, resulting in chronic bronchitis; coughing and the presence of particles in the alveoli can lead to emphysema (breaking the walls of the alveoli) |
| Tar | A carcinogen - increases the risk of lung cancer; lines the air passages, increasing mucus production and paralyzing and damaging cilia, causing bronchitis. |

1. **State the differences in composition between inspired and expired air.**

|  |  |  |  |
| --- | --- | --- | --- |
| *Gas* | *Inspired air %* | *Expired air %* | *Explanation* |
| Nitrogen | 79 | 79 | Not used or produced by body processes |
| Oxygen | 21 | 16 | Used up in the process of respiration |
| Carbon dioxide | 0.04 | 4 | Produced in the process of respiration |
| Water vapour | Variable | Saturated | Produced in the process of respiration, moisture evaporates from the surface of the alveoli |

1. **Use lime water as a test for carbon dioxide to investigate the differences in composition between inspired and expired air.**

*IGCSE Biology* (Jones & Jones), p. 122, activity 9.5 ‘comparing the CO2 content of inspired & expired air’.

1. **Investigate and describe the effects of physical activity on rate and depth of breathing.**
2. **Explain the effects of physical activity on the rate and depth of breathing.**
* The volume of air breathed in and out during normal, relaxed breathing is about 0.5 litres (the tidal volume);
* The breathing rate is about 12 breaths per minute;
* During exercise, the volume inhaled (depth) increases to about 5 litres ( depending on the age, sex, size and fitness of the person);
* The maximum amount of air breathed in and out in one breath is the vital capacity;
* The breathing rate can increase to over 20 breaths per minute;
* The total lung volume is greater than the vital capacity because some air always remains in the lungs (otherwise the lungs would collapse and the alveoli walls would stick together)
* Breathing rate and depth increase to absorb more oxygen for the muscles as exercising muscles need to respire more to get more energy.