Cellular Respiration: Aerobic & Anaerobic Respiration

Respiration

Aerobic & Anaerobic respiration: Respiration is a process that will occur in every living organism where the end result is energy. Aerobic respiration is the process where oxygen is used in the production of cellular energy also to break down energy that comes into a cell, it produces 36ATP. Mitochondria is a key organelle. The process in aerobic respiration is glycolysis which occurs in the cytoplasm of the cell next molecules have a chemical reaction known as the Kerb's cycle finally the process is finished with electron transport system. The chemical equation is $C_6H_{12}O_6 + 6O_2$? $6CO_2 + 6H_2O$.

Anaerobic respiration is the breakdown of food that doesn't require help from oxygen. The process is very fast unlike aerobic respiration however 2 net ATP is produced for every glucose molecule. There is limitations for glucose to breal down causing it to turn into lactic acid. The chemical equation is $C_6H_{12}O_6 + 6O_2$? $6CO_2 + 6H_2O$.

Stages of respiration

Cellular respiration: In cellular respiration there are 3 stages that occur, these stages are glycolysis, the Krebs cycle and electron transplant. The first stage (glycolysis) which happens in the cytoplasm is where the process of one molecule divides in to 2 molecules of pyruvate. 2 molecules of ATP have the energy to split the glucose. Glycolysis doesn't require oxygen which makes it anaerobic respiration.

The Krebs cycle: 2 numbers of molecules are needed in the splitting of glucose. As there are 2 molecules that is produced, they will enter the mitochondria which starts the Krebs cycle. The Krebs cycle (also known as the citric acid cycle) starts in the combination of oxaloacetate and acetyl-CoA. This reaction causes the release of energy after the completion of the Krebs cycle. Molecules will absorb the energy except from carbon dioxide which is a waste product. Finally, in the Krebs cycle it will need to make an oxaloacetate molecule as in the beginning glucose was divided in to 2. As a result of this the first glucose molecule has been completely broken down.

Electron transport chain: Electron transport chain is the final step of aerobic respiration and in the electron transport chain there are four protein complexes that are located in the inner mitochondrial membrane. This is where everything happens in a downward order of energy also where electron carriers disposes of electrons and protons that were gained during glycolysis and citric acid cycle. Electrons are given to the first and second protein complex when NADH + H + and $FADH_2$ become oxidised. These proteins begin to oxidise as they go through the electron transport chain, the electrons will continue to go down until it hits the bottom. The protons which were given by NADH + H + and $FADH_2$ are moved to the other side of the inner mitochondrial membrane by active transport.

Factor affecting rate of respiration

One factor that affects the rate of respiration is temperature. Temperature affects the rate of respiration when the temperature increases it will result in the respiration rate also increasing. However, if the temperature has become too high this will result in enzymes becoming denatured. There are many reasons as to why the respiration rate may decrease one reason could be that the cells may not be getting enough oxygen as they require resulting in slower rates. Another factor that could affect the rate of respiration could be the amount of water that is available. Plants that live in the desert have low availability of water. As temperature increases so does the rate of respiration this applies to water availability as well as increase in water will also increase the rate, this rate will gradually increase and will not rapidly increase as there has to be a certain amount of water needed before respiration rates will increase. Another thing that is a factor effecting rate of respiration is the effect of chemical substances.

How to measure respiration rate and what effects it has on body

Respiration rate is measured by observing the amount of breaths a person may take within a duration of one minute without taking part in any form of exercise as respiration rates could increase by this and also other factors such as having a fever or having a medical condition. One way you can measure respiration rate is by also checking heart rate, oxygen saturation, temperature and blood pressure (these are known as the vital signs) as all of these play a big factor in respiration and its rate.

Functions in the body that can affect the rate of respiration are the blood pH level to see if the blood is too alkaline or too acidic this is found by the carotid and aortic sensors. A fast respiration rate may indicate that the blood pH level is low. If the blood pH level in your body drastically changes you may hyperventilate which means that you will be breathing very fast which causes you to exhale more than you inhale causing the amount of oxygen to increase and carbon dioxide to decrease.

Also, things that can affect the rate of respiration are chemicals such as drugs and alcohol. Illegal drugs such as heroin can slow down the rate of respiration to a dangerous level and make users feel depressed and antisocial however illegal drugs such as cocaine will increase the respiration rate and make the user feel euphoric. Alcohol has the same effect as heroin does on the body but not to the extent to heroin.

One more way is by measuring the blood to oxygen level. The normal level of blood to oxygen level is 80-100 mmHg. When the blood to oxygen level decreases below 50 this is seen as very dangerous and should be treated. However, there are other respiratory systems that will come in to play if this one is not effective.

Ways to control your respiration rate is by doing forms of exercise such as swimming and yoga as these forms of exercises will control breathing rates. The cerebral cortex controls movement in the body which then starts to have a pattern of breathing that is controlled.

Blood Pressure

Blood pressure is the pressure of blood that is flowing around the circulatory system. It relates to the force that is being applied not the heart. Blood pressure is measured in millimetres of mercury (mmHg). There are medical instruments that allow doctors to measure blood pressure

this medical instrument is called a sphygmomanometer. A person with normal blood pressure generally will range between 120mmHg – 80mmHg as this range means you are healthy and there will be a decreased risk of a person having a heart attack or stroke or even heart disease. If a person's blood pressure is higher than this, it will essentially mean they are at a risk of having a stroke or heart attack. There are many places where they check blood pressure some of these place includes:

1. NHS health check
2. Some pharmacies
3. GP surgery
4. At home for the elderly that cannot move a lot
5. Some work places before a job

The NHS will check blood pressure of adults aged 40 – 74 who are in England. Some pharmacies will test blood pressures as it may be the fastest way to check a person's blood pressure. GP surgeries will check blood pressure as it is information that is directly from their doctor and if there are any problems the doctor can take action immediately. For elderly people who are not able to go outside their house due to medical reasons may have a trained nurse to go to their house and check their blood pressure. Some workplaces may ask for blood pressure if the job is very challenging for example if you want to be an astronaut your health will be checked very carefully to make sure there is no risk to send out anyone with health problems. A doctor may recommend having a blood pressure test if their patient has a higher risk of developing it, for example, if the patient is overweight, has a family history of having blood pressure or heart disease.

Peak Flow

A peak flow mater is a medical instrument that records the strength and force of how fast you exhale out of your lungs. A peak flow test can be done with your doctor however you can also take this test at home after you are taught how to use it and this test is normally done on patients who have asthma or breathing problems. To take a peak flow method the patient has to be in a comfortable position where they can sit or stand. Before you use the instrument you have to make sure that the reading of the peak flow meter is at 0 to get an accurate reading. Also the peak flow meter must be held horizontally and not vertically as if it is held vertically the scale may move downwards. Next the patient must place the mouth piece around their mouth and breathe in as much as you can, after that the patient must blow into the peak flow meter as fast and for as long as they can. Next the doctor will take a record of the reading, the patient must do this three times in order to get an average also the best reading will be the patients peak score. A peak flow test is linked to respiration as it provides information on a person's repertory system and how well it is working providing information about the breathing. A doctor may recommend a patient to have a peak flow test done if they have asthma, a faulty lung or transplanted lung, if they have chronic obstructive pulmonary disease and more. From this the doctor will take measurements to see if the patient requires and assistance for example if a person has problems sleeping at night for example sleep apnea they may be told to use a CPAP machine.

Spirometry

Spirometry is a medical instrument that is used to identify and diagnose lung conditions by measuring the force of someone's breathing as they breathe out and breathe in. Spirometry tests are normally carried out by doctors or consultants. The patient will sit down in a comfortable position before they start the test. Next the patient will be instructed on what they must do to continue such as breathing in and out before the test starts. The doctor or consultant may place a clip over the patient's nose to reduce any air the will be lost out from the nostrils. Next the doctor or nurse will instruct the patient to hold their breath for a few seconds then to exhale as fast as they can. This test will be repeated at least three times to get an average. The highest results will be used as your reading however if your results do not correlate then you may be asked to redo the test. A spirometry trace is what is produced from a spirometry test. You can find important results from a spirometry test such as how well your lungs work. From taking these tests you can see the capacity and volumes of your lungs, the rate of flow and even gas exchange which is in your respiratory system. From all of this doctor will be able to diagnose conditions such as chronic obstructive pulmonary disease also known as COPD, asthma, chronic bronchitis, emphysema and other breathing conditions. The NHS and other medical specialists offer spirometry tests to people who would like to test their breathing and lung efficiency.

Basal metabolic rate

The basal metabolic rate is also known as BMR, is a form of measurement that measures the energy intake the body uses when it is at rest. The BMR would be looking at the number of calories a person may burn if they were to be asleep all day. The formula is J/(hkg). The basal metabolic rate is calculated in men and women differently. In men the basal metabolic rate is 66 + 6.23 x weight in pounds + 12.7 x height in inches – 6.8 x age in years. However, in women it is 665 + 4.35 x weight in pounds + 4.7 x height in inches – 4.7 x age in years. The basal metabolic rate can be affected by age, height and gender also body size. A person with a higher percentage of fat may experience a lower metabolic rate; this may be because fat tissues have a lower metabolic activity than muscle tissues do. This is why athletes are able to consume large amounts of food without gaining fat tissues and they have more muscle tissues and a faster metabolic rate than most normal adults. People who would want to use the Basal Metabolic Rate may be people who are either over weight or underweight as they may have been asked to do this by their doctor or people may want to see if they are healthy with their weight and height. Doctors and other science professionals such as sports scientists may also use a basal metabolic rate chart to improve the health or body mass ratio of an athlete they are working with. Athletes such as Mo Farah would have been recommended to use a peak flow, bmr and also blood pressure test as it is essential he is in a good condition before he starts a race. Sports scientists will use a peak flow machine to see how strong his lungs are, and they could recommend ways in which to make his breathing better during long races the sport scientist could also use a spirometer as it could give a more detailed result however it works the same as a spirometer. One of them could be for Mo Farah to train in places in high altitudes as it will expand his lungs. Long-distance runners also use fast-twitch muscles which then converts into slow-twitch muscles. The sports scientist may use a blood pressure test on a long-distance runner to test how much force blood is being pumped through to the heart and in long-distance runners their hearts are moving at a rapid speed, also how much pressure is being applied to the heart. A runners blood pressure may be more than the normal blood pressure which is 120/80 as runners are more active than the average human as a result their hearts will be faster which causes blood pressure to rise.

Experiment

Method:

1. Firstly, I set water baths to the temperatures 30°C, 40°C 0, 50°C, 60°C.
2. Next, I put a thermometer in each of the water baths to make sure the temperature was accurate to avoid any mistakes.
3. After that, I added 10ml of 5% glucose solution into a test tube by using a syringe also placing it in a test tube rack that was in the water bath.
4. After that, using a syringe I measured 5ml of the yeast solution and put it into a test tube.
5. Next, I placed the bung and delivery tube on the test tube.
6. After that, I placed a 400ml beaker containing tap water at the end of the delivery tube to collect CO2 bubbles.
7. To start the reaction I started shaking the test tube gently
8. Next, I placed the test tube into the water bath and started timing on a stop clock.
9. Every 30 seconds for 5 minutes I recorded the bubbles that appeared
10. After that I repeated the same experiment three times for accurate results
11. After doing this procedure for every temperature I plotted each result in a table and also plotted it in a graph Variables

- Independent variable: Were the temperatures of the solution
- Control variable: Was the concentration, type of yeast, amount of yeast, timing, concentration, sugar and time limit.
- Dependent variable: The number of bubbles

Evaluation:

In evaluation, I think that this experiment is repeatable as the results can be reproduced again with mean results which would show the accuracy or the correlation between the old and new experiment. I found that in the experiment, as the temperature increased would results in the reaction to also increase up to a certain point. The reaction would stop increasing when the enzymes become denatured. I would make some modifications in my experiment such as using a gas syringe instead of a normal syringe to increase accuracy also the different gas bubbles have different volume of gas inside them. Another thing I would modify is the duration I recorded the bubbles. I would time for at least 10 minutes instead of 5 minutes to increase the accuracy of the results also to get better information about the experiment. A final thing I would modify in my experiment is that I had different people that were doing different things in order to increase accuracy I would have one person timing one person measuring and one person activating the enzyme by shaking, instead of people switching jobs during trials.

Conclusion

In conclusion, I found that my results showed that the optimum temperature for yeast works best at 40oC as it had produced the most amount of bubbles than any of the other temperatures. This suggests that yeast enzymes may not be fully effective at temperatures below 40oC as the temperature isn’t at the optimum for yeast enzymes to be effective and that yeast enzymes become denatured at temperatures over 50oC or 60oC as they slowly stop working as the

temperature may be too high, which was evident in my results as most of the bubbles were able to be produced indicating that yeast was not able to respire. Also, I found results that had anomalies when the experiment was conducted at 50oC as it had more bubbles that 60oC which was not something I expected.