**BTEC Diploma Health & Social Care**

**BTEC– Unit 5**

Assignment 4 **Submission date**………………………………..

**TASK:** *You will require to produce a report to explain how the body uses energy. To do this you firstly need to explain what energy is. You also need to identify the body systems involved in creating and using energy. The physiology of two of these systems should be explained.*

*.***P4: E**xplain the physiology of **two** named body systems in relation to energy metabolism in the body

**M1** Discuss the role of energy in the body.

**D1** Analyse how two body systems interrelate to perform a named function/functions

**Remember for all of your BTEC Health & Social Care Coursework**

***Self-check: Tick the boxes when you have checked that have completed each task***

* **Font size**: 12
* **Font Style**: Comic Sans
* **Header**: Your name and Group.
* **Spacing:**1 ½ line
* **Bold and underline all titles and subtitles. Main titles should be in the centre of the page; subtitles left aligned.**
* **Proof read and spell check all of your work before submission for assessment.**
* **Save any work to the hard drive on your computer from USB. Email copies of your work to yourself as an attachment.**
* **You will need to save all previously assessed work and hand it back in with any re-drafts of your work.**

You must reference your work and include these in a bibliography for the report.

***Don’t just rely on the Stretch & Whitehouse Book for your information use a variety of resources for your information. Remember the power points includes references and sources of further information.***

Try to include images and diagrams to explain difficult points

**1**: Main title : **The Use of Energy within the Body and the Body Systems associated with Energy Metabolism.**

**2** : **Introduction**

Explain that this report will explore the concept of energy and not only why energy is important to the body but how the body gets its energy and the systems that are involved in this.

Give a definition of energy and the different forms in which energy can exist.

Identify the laws of thermodynamics.

3. **The role of energy in the Body**

Identify why the body needs energy.

Explain that chemical energy is the most common type of energy used within the body and what chemical energy is.

Explain that these chemical processes are known as metabolism.

Identify that metabolism includes **two** aspects and explain both Anabolism and Catabolism.

Explain that the creation of energy takes place within the cells of the body and this is known as cellular Respiration.

Identify here that there are three body systems involved in the supply of the materials to the cells in order to produce energy in the body.

4. **Cellular Respiration**

Describe the process of cellular respiration

5. **An overview of the body systems involved in ensuring the body receives the components to make energy.**

Here you need to give a brief overview of the body systems involved (*this will be a paragraph –see the power point and pg199 to assist you.*

Now explain that you will be looking at two of these systems in more detail and the systems you have chosen are the Respiratory system and the cardiovascular system but before you do this you are going to explain the term diffusion.

6. **Diffusion.**

Define the term diffusion *– (page 469 has a very simple definition.)*

Describe diffusion *(see the handout & the following website to assist you* [*http://www.bbc.co.uk/schools/gcsebitesize/science/add\_aqa\_pre\_2011/cells/cells3.shtml*](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/cells/cells3.shtml)

**7. The physiology of the respiratory system in relation to energy metabolism.**

Write a brief introduction explaining that the key function of the respiratory system is to supply oxygen to the body and get rid of waste gases, primarily Carbon dioxide.

Identify that this takes place within the lungs –*You might want to include an image of the respiratory system here*

Identify that this process is ventilation.

**8. Ventilation and Gaseous Exchange**

*Before you start read page 208 -209 and the power point slides -Breathing/ventilation – Inhalation. Alveoli. Gaseous Exchange and Breathing / Ventilation – Exhalation.*

Explain that ventilation is the movement of air in and out of the lungs.

Identify the structures involved in assisting with this.

Identify that there are two aspects to ventilation or breathing. *Again you might want to include diagrams.*

9. **Inhalation or Inspiration**

Describe the process of inhalation and the passage of air containing oxygen into the lungs *Again you might want to include diagrams and images.*

10. **Gaseous exchange**

Describe the process of gaseous exchange *Again you might want to include diagrams and images.*

11. **Exhalation or Expiration**

Describe the process of exhalation and the passage of air containing carbon dioxide out of the lungs. *Again you might want to include diagrams and images.*

12. **How ventilation is controlled.**

Explain how ventilation is control *you might want to include the flow chart from page 209*

13. **The physiology of the cardiovascular system in relation to energy metabolism.**

Write an introduction identifying the key structures of the cardiovascular system.

Explain about the different types of blood vessels.

Explain the role of the system in energy metabolism. *You might want to include images here*

Describe the absorption of glucose from the digestive system and its transport.*(see Stretch 2002 handout to assist and my example below) You might want to include a diagram of the villus and its blood supply.*

**14. Circulation of Blood through the Body and the Cardiac Cycle**

Explain that the circulation of blood follows a specific route through the body and why this is important.

Identify this is a double circulation and explain what this means. *Find a clear diagram that shows the double circulation to include in your text*

Explain that although blood is separated both sides of the heart work in unison (the cardiac cycle *see p202 and the power point*) *Find an image of the heart showing the structures.*

Explain the cardiac cycle.

15. **Pulmonary Circulation**

Explain Pulmonary Circulation.

16. **Gaseous exchange in the Pulmonary Circulatory system.**

Explain the role of blood cells in the transport of oxygen *(see Kingston 2001 handout)*

17. **Systematic Circulation.**

Explain systematic circulation.

18. **Gaseous exchange within the capillary circulation of the tissues**

Explain how oxygen diffuses from the capillary circulation into the tissues.

Explain the body can usually supply enough oxygen for cellular respiration to function effectively however if necessary to cells can create energy without an adequate supply of oxygen.

Describe anaerobic respiration.

**19. Conclusion**

Write a conclusion about the two systems working together and if they didn’t then the body would not receive the substances (oxygen & glucose) required to create energy and would not be able to remove the waste product carbon dioxide produced meaning the body would be unable to function as energy would not be produced,

***Sample of a report***

**The Use of Energy within the Body and the Body Systems associated with Energy Metabolism.**

This report will look at why the body needs energy, how the body uses energy and the systems involved in supplying the materials needed to create energy in the body. Before we start to look at this in detail it is probably necessary to define energy.

“Energy is defined as power which may be translated into motion, overcoming resistance, or effecting physical change; the ability to do work.” (medical-dictionary.thefreedictionary .com 2013)

Energy is present and exists in several different forms including Chemical, Heat, Light, Sound, Electrical and Nuclear.

The laws of thermodynamics basically explain how energy is created in its different forms and used.

The First law states that “Energy is not destroyed or lost but passed from one form to another.” This means that you can change energy form one form to another but you can’t destroy it. The Second law states that “When energy is exchanged, the efficiency is imperfect and part of the energy will escape.” (Morton et al 2000) this means that some of the energy will escape in the form of heat.

**The role of energy in the Body**

The human body requires energy in order to function properly. (livestrong.com) The amount of energy you need depends upon your age, sex and your level of activity. (bbc.co.uk 2013) Energy is used all the time for body processes, these include muscular activity & movement, to circulate blood, breathing & taking in oxygen, using oxygen within the body, transmitting nerve impulses, digesting food, making new cells and making enzymes and hormones. Chemical energy is the most commonly type of energy used within the body; basically this involves altering the chemical bonds that hold molecules together.

When a new bond is made between two atoms energy is required and this is usually in the form of heat. For example: when a hydrogen atom and two oxygen atoms combine to make water. When a bond is broken and the atoms are released energy is also released. For example when Glucose combines with oxygen and is broken down to form energy, water and carbon dioxide.

These chemical processes together are known as Metabolism. This is defined as “The chemical processes occurring within a living cell or organism that are necessary for the maintenance of life. In metabolism some substances are broken down to yield energy for vital processes while other substances, necessary for life, are synthesized.”(free dictitionary.com 2013).

The process of creating or synthesising substances such as the proteins and fats that make up body tissue, from simpler chemical is known as anabolism. The process of breaking down complex molecules into simple ones with the release of energy is known as catabolism.

The creation of this chemical energy takes place within the cells of the body and this is known as Cellular Respiration or Internal Respiration and involves three main body systems to supply of the materials to the cells in order to produce energy in the body. These systems are the digestive, cardiovascular and Respiratory systems. (Stretch And Whitehouse 2010)

**Cellular Respiration**

The process of cellular respiration is a very complex reaction that takes place within the cells of the body and involves many enzymes, coenzyme and molecules. Each and every step is a series of complex chemical reactions, which helps in the production of energy. (buzzle 2013). This process takes place in the mitochondria of the cell and involves three stages - Glycolysis, Krebs cycle and Electron Transfer.

Basically Cellular respiration allows the body to use energy stored in the chemical bonds of glucose (C6H12O6). This energy in glucose is used to produce Adenosine Triphosphate (ATP), this is an unstable molecule, the bonds of which are easily broken to provide energy.

ATP breaks down to ADP (Adenosine Diphosphate) releasing energy from the chemical bonds.

ATP → ADP + P (Phosphate molecule) + free energy

ADP is then recycled to be built up again into ATP using the energy released from Glycolysis -

Glucose + Oxygen = Carbon Dioxide + Water + ENERGY (C6H12O6 + 6O2 = 6CO2 + 6H2O + Energy)

The Energy released combines with ADP + a Phosphate molecule to create ATP. (Food energy + ADP + P = ATP). These Catabolic reactions generate energy to make ATP, and the ATP energy is used to drive anabolic reactions, such as the replacement of cell parts, growth and cell division, and special functions (such as secretion, absorption, contraction, or signalling).

**An overview of the body systems involved in ensuring the body receives the components to make energy.**

The Respiratory, Digestive, Cardiovascular systems under the control of the Nervous system are all involved in ensuring that the body cells receive all the necessary components for energy production. The Digestive System breaks down the foods we eat to produce Glucose which is needed for energy production. The respiratory system supplies the oxygen that is required to create energy and expels the carbon dioxide which is a waste product of energy production. The Cardiovascular system is responsible for transporting the Oxygen & Glucose to the cells and for removing the waste products (Carbon Dioxide & Water) so they can be excreted from the body. This report will look at the Respiratory and Cardiovascular systems in more detail. There are many processes involved in keeping the body supplied with energy including diffusion which is important in ensuring molecules can get to where they are needed.

**Diffusion.**

This is the process which allows dissolved substances to pass through the cell membranes to get into or out of a cell. The molecules move freely from a high concentration to an area of lower concentration, so for example oxygen will move from the lungs across the cell membranes and into the blood whilst carbon dioxide will move from the blood into the alveoli because they have a high concentration of oxygen and a lower concentration of carbon dioxide. The greater the difference in the concentrations the faster diffusion takes place, the difference is known as the concentration gradient.

I will now explain how the respiratory system and the cardiovascular system are involved in ensuring the body cells have the components required to produce energy.

**The physiology of the respiratory system in relation to energy metabolism.**

The respiratory system plays a key role in the metabolism of energy within the body. This system is responsible for the supply of oxygen which is needed for cellular respiration and the removal of waste gases such as carbon dioxide. The taking in of oxygen and the removal of carbon dioxide takes place within the lungs during breathing, the technical term for the process is ventilation.

**Ventilation and Gaseous Exchange**

Breathing or ventilation is the movement of air in and out of lungs to supply oxygen and remove the waste products carbon dioxide and water. (Stretch & Whitehouse 2010). Whilst the exchange of these gases occurs deep within the lungs, the mechanism of ventilation involves the intercostal muscles between the ribs and the diaphragm. The process of ventilation involves two aspects inhalation inspiration and exhalation or expiration. (BBC 2013, Stretch & Whitehouse 2010)

**Inhalation or Inspiration**

During Inhalation (breathing in) the intercostal muscles and the diaphragm contract, this causes the chest cavity to enlarge and the lungs to expand and draw in air. It is the partial vacuum created in the thoracic cavity that draws air through the nose, pharynx, larynx, trachea, and down into the two bronchi, through the bronchioles and into the alveoli sacs of the lungs. This process occurs to equalise the pressure with the external environment (Stretch & Whitehouse 2010). As the air is drawn into the alveoli sacs this allows gaseous exchange to occur by diffusion. (BBC 2013, Stretch & Whitehouse 2010)

**Gaseous exchange**

At the end of the bronchioles are the alveoli these are globe like sacs that are adapted to make gaseous exchange in lungs happen easily and efficiently. Alveoli are many microscopic blind-ending air pouches which are connected to the terminal bronchiole via an alveoli duct. The alveoli have single cell epithelial walls known as the alveoli-capillary membrane. This separates the air inside the alveolus from the blood-carrying capillary on the outside of the alveolus. This is the membrane through which the gases oxygen and carbon-dioxide are exchanged during the ventilation process. The gases move by diffusion from where they have a high concentration to where they have a low concentration. This means that the oxygen from the air drawn into the alveoli during inspiration diffuses into the blood and carbon dioxide diffuses from the blood into the air in the alveoli to be expired from the lungs.

**Exhalation or Expiration**

The high concentration of carbon dioxide is then removed from the alveoli during exhalation (breathing out). The main force in expiration is the elastic recoil of the alveoli and relaxation of both the diaphragm and intercostal muscles. This action reduces the size of the thoracic cavity, thereby increasing the pressure and forcing air out of the lungs removing carbon dioxide. (BBC 2013, Stretch & Whitehouse 2010 Teach PE 2013)

**How ventilation is controlled.**

The Process of respiration is control by the nervous system, Chemoreceptors in the walls of the blood vessels that detect the levels of carbon dioxide in the blood and if cellular respiration is increased, the rising levels of Carbon Dioxide triggers the chemoreceptors and messages are sent to the Medulla of the Brain. Nerve impulses are then sent to the diaphragm & the intercostal muscles to increase the rate and depth of ventilation; which in turn speeds up the exchange of gases at the alveoli.

The flow chart below gives you an overview of the process of breathing and how air is supplied to the alveoli to ensure gaseous exchange can occur within the alveoli.

**The physiology of the cardiovascular system in relation to energy metabolism.**

The cardiovascular or circulatory system is composed of the heart that pumps blood around the body through a system of blood vessels; these are arteries, capillaries and veins. Arteries are blood vessels that carry oxygenated blood (oxygen rich blood) away from the heart to the organs tissues and cells of the body, these arteries branch to become finer arterioles until they join the capillaries. There is however one artery that carries deoxygenated blood away from the heart to the lungs. Capillaries are fine one cell walled vessels that allow oxygen and nutrients to diffuse out of them into the tissue fluid that leaks from the capillaries and bathes the cells; the waste products diffused in the opposite direction. Venules are joined to the capillaries and carry deoxygenated blood (low oxygen & high carbon dioxide containing blood to the veins back to the heart.( Kingston 2001) The key function of the system is the transport of oxygen and glucose to the cells of the body for production of energy and the removal of the waste products of cellular respiration. (BBC 2013, Kingston 2001, Stretch & Whitehouse 2010).

The circulatory system is vital in the transfer of Glucose from the digestive system to the cells in order to produce energy. Glucose passes from small intestine via finger like projections called villi, these increase the amount of surface area available in the small intestine for the absorption of nutrients. Each villus has a network of capillaries which enable the glucose molecules to pass directly into the capillaries; from here glucose is transported to the liver via the Hepatic portal vein. The glucose can then be transported around the body to where it is required in the blood for immediate use or turned in Glycogen and stored in the liver and muscles until it is required. (Stretch 2002)

**Circulation of Blood through the Body and the Cardiac Cycle**

The blood follows a specific route through the heart and around the body, ensuring that all areas of the body get the oxygen and glucose they need for energy metabolism and that carbon dioxide and water are removed (Kingston 2001). In order to do this effectively the body has a double circulatory system. It comprises two separate circuits and blood passes through the heart twice on one circuit of the body. (BBC 2013, Kingston 2001). Each side of the heart is responsible for one of these circuits. The left side of the heart operates the systemic circulation which is responsible for pumping the oxygen rich blood through the body. The right side of the heart is responsible for the pulmonary circulation that circulates oxygen poor blood back through the lungs to collect oxygen.

Although oxygenated and deoxygenated blood are separated in the normal healthy heart both sides of the heart work in unison. The cardiac cycle involves all the activities of the heart through one complete heart beat (Cliffsnotes.com.2013) This cardiac cycle has two phases: the systolic phase and the diastolic phase. The systolic phase refers to the period when the ventricles and atria of the heart contract, while the diastolic phase is the period between contractions when the ventricles relax and fill with blood.

These are the stages of the cardiac cycle:  
1. The Atria contract and blood is pushed into the ventricles under pressure.

2. The Ventricles bulge and the pressure forces the tricuspid & bicuspid valves shut. This causes the Atria to relax and begin to fill with blood.

3. The Ventricles begin to contract and the pressure in the blood rises forcing open the aorta & pulmonary valves.

4. Systole in the ventricles pushes blood into the aorta and pulmonary artery. These walls are elastic & begin to expand.

5. The Ventricles begin to relax and blood falls back with the effect of gravity for a few moments and catches in the pockets of the semi-lunar valves, pressing them together & closing off the opening.

6. The Tricuspid & Bicuspid valves are forced open and blood rushes from the filled atria into the ventricles during their diastolic phase. On being filled to about 70%capacity, atrial systole occurs and the heart has completed its cycle. (Moonie 2000)

**Pulmonary Circulation**

The Pulmonary Circulation circulates deoxygenated blood to the lungs to remove carbon dioxide and collect oxygen. Deoxygenated blood enters the right side of the heart through the Vena Cava and collects in the right atrium. The blood is forced through the tricuspid valve into the right ventricle by the contraction of the atrium. The right ventricle contracts forcing blood through the semi-lunar valve/pulmonary valve into the pulmonary artery. The semi-lunar valve stops blood flowing back into the ventricle when the ventricle relaxes. Blood is moved through the pulmonary arteries (these are the only arteries to carry deoxygenated blood) to the pulmonary capillary system where gaseous exchange takes place before being returned as oxygenated blood via the pulmonary veins (the only veins to carry oxygenated blood) to the left side of the heart to be sent to the body organs, tissues and cells. (stretch & Whitehouse 2010, Moonie 2000)

**Gaseous exchange in the Pulmonary Circulatory system**

Deoxygenated blood is transported to the pulmonary capillary system which surrounds the many alveoli; carbon dioxide is diffused from the high concentration of the capillary system into the lower concentration of the alveoli sac. Oxygen diffused from the alveoli of the lungs into the blood and attaches to Haemoglobin of the erythrocytes (red blood cells) to form Oxyhaemoglobin. The oxygenated erythrocytes in the blood are then returned to the left side of the heart via the pulmonary veins to be transport to the cells by the systematic circulation. (Ivy Rose 2013, Kingston 2001, Teach PE 2013)

**Systematic Circulation.**

Freshly oxygenated blood enters the left atrium via the 4 pulmonary veins. It is forced through the mitral valve into the left ventricle of the heart. From there it is forced through the aortic semi-lunar valve into the Aorta.

The blood is then distributed around the body via the arteries and the finer arterioles to the capillary network of the organs, tissues to supply the cells with oxygen. (BBC 2013, Moonie 2001, Stretch & Whitehouse 2010)

**Gaseous exchange within the capillary circulation of the tissues**

When the oxygenated blood reaches the capillaries in the working tissues, the raised acidity level in the tissue fluid created by the higher carbon dioxide levels and the low oxygen level causes the oxyhaemoglobin to be broken down and the oxygen is released to the tissues. The carbon dioxide and water diffuse from the cells and the tissue fluid into the plasma of the blood to be transported via the venous system back to the heart and the pulmonary circulatory system to be removed from the body.

Usually the cells can receive an adequate amount of oxygen to meet their needs and maintain aerobic cellular respiration. However in circumstances when there is an inadequate supply of oxygen for example during physical activity they can create energy without oxygen. This is known as anaerobic respiration, with no oxygen available, glucose is burned within the cell to produce energy and lactic acid. After anaerobic activity, oxygen is needed to neutralize and break down the lactic acid that has been produced into carbon dioxide and water so that it can be expelled from the body. (BBC **2013**, Moonie 2001, Stretch & Whitehouse 2010)

**Conclusion**