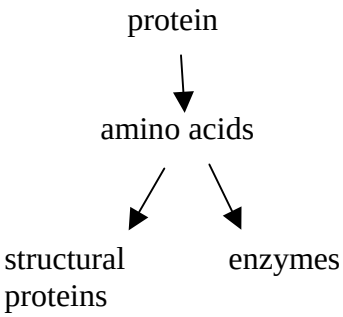
IGCSE and GCSE Biology. Answers to questions

Section 3. Human physiology.

Chapter 10 Food and diet

Page 87

1. **a** Milk, cheese, eggs, beans.
   b Peas, beans, cereals (e.g. bread).
2. Proteins are needed to make cytoplasm and all the tissues of the body. They also make the enzymes needed for chemical changes in the cells.
3. In theory you could survive on proteins and lipids. Both these foodstuffs can be converted into energy which is normally provided by carbohydrates. You might be disadvantaged by a lack of dietary fibre and vitamin C (*See* p. 88).
4. When fats are oxidised they produce a large amount of energy, some of which is released in the form of heat. A layer of fat under the skin may have insulating properties and reduce loss of heat.
5. **a** Proteins contain nitrogen. Lipids do not.
   b Proteins have about half the energy value of lipids.
   c The principal use of proteins is to provide the amino acids needed for building other proteins in the cytoplasm of the cells which form the tissues of the body. They are also used to produce enzymes. Lipids are a means of storing energy.
6.



Page 89

1. **a** Red blood cells **b** All tissues **c** Bones and teeth **d** All cells **e** Thyroid gland.
2. (top left). Milk and its products such as cheese and yoghurt are good sources of proteins, lipids and calcium.
   (top right) Most will contain some carbohydrate (e.g. banana), all will contain vitamins (e.g. tomato and orange, vitamin C. Green vegetables, vitamins A and C. Most of them will provide dietary fibre.
   (bottom left) All will provide protein. The mackerel will contain lipids. The meat will provide iron.
   (bottom right) Mainly carbohydrate, some B vitamins and dietary fibre.
3. Green vegetables such as cabbage and lettuce contain vitamin A and also dietary fibre.
4. A diet consisting of only one source of food is likely to be deficient in one or more essential minerals or vitamins.
5. Only **a** is likely to give meaningful results. The added Vitamin C of **b** and **c** is unlikely to demonstrate a need for Vitamin C even if the rabbits show some benefit. In **d** you would not know whether the outcome was due to lack of Vitamin C or some other property of the food. In fact, rabbits do not appear to need vitamin C, so the results of **a** confirm this.

Page 93

1. Proteins, carbohydrates and lipids, vitamins, mineral salts and water, a source of dietary fibre.
2. Protein cannot be stored in the body. If there is a large intake of protein, the body will take what it needs to build tissues and make enzymes and the remainder will be oxidised to provide energy which is a wasteful use of an important nutrient.
3. For all three, an adequate intake of protein is essential plus the calcium needed for the milk in the breast-feeding mother and the bone formation in the embryo and the growing child.
4. **a** An apple has far less carbohydrate than a chocolate bar so it is unlikely to cause weight gain.
   b A chocolate bar contains much more carbohydrate than an apple and will better meet your energy needs.
5. The fried potato ('chips') contains a good deal of fat which gives about twice the energy of the carbohydrate in boiled potato.
6. A high fibre diet will make you feel 'full' without taking in an excess of energy-rich food which can be converted to fat.
7. Hard physical work needs a great deal of energy which can be obtained best from carbohydrates and lipids.
8. *See* 'Growing children' on p.91. The text should have stated that the figures are '*per day*' From these figures you would calculate that the baby needs 1.53 x 5 = 7.62 g of protein per day though there is little point in going to 2 decimal places. In fact 7.6 g seems too low for a 6 month baby. The text needs to be revised.
9. During sleep, only basal metabolism is taking place. If 8 hours sleep needs 2400 kJ, 24 hours basal metabolism would need 3 x 2400 = 72000 kJ.

Chapter 11 Digestion, absorption and use of food.

Page 98

1. The three functions shown are storage, digestion and absorption.
2. **a** The pancreas pours pancreatic juice into the duodenum.
   b The salivary glands secrete saliva into the mouth.
3. Epithelium, circular muscle, longitudinal muscle.

Page 101

1. The airways are cut off. The soft palate closes the nasal cavity; the tongue, the epiglottis and muscles in the glottis, seal the top of the windpipe.
2. The solid food has to be broken down to a liquid from which the nutrients can be absorbed through the gut wall.
   Plants build their food from carbon dioxide water and minerals. They do not take in solids.
3. **a** Starch is digested in the mouth, the duodenum and the small intestine.
   b Protein is digested in the stomach, the duodenum and the small intestine.
4. Pepsin acts on only one kind of substance (protein) and works best at a particular pH.

Page 103

1. **a** Starch is digested to glucose.
   b Proteins are digested to amino acids.
   c Fats are digested to fatty acids and glycerol.
2. The small intestine is long; it is lined with vast numbers of villi. Both these factors give the small intestine a large absorbing surface. The epithelium is thin, which allows rapid diffusion or active uptake of digested food. There are numerous capillaries to carry off the digestion products.
3. In the stomach the enzyme, pepsin, breaks the protein down to form peptides. In the duodenum and small intestine the peptides are broken down further, by enzymes, to form amino acids. The amino acids are absorbed through the intestinal lining to reach blood vessels which join up to form the hepatic portal vein. This vein carries the amino acids to the liver which makes them into new proteins or alters their composition so that they can be used for energy production.
4. In the duodenum the starch molecules are broken down to glucose. In all the cells of the body, glucose is broken down to carbon dioxide and water by respiration.

Page 105

1. The liver controls the glucose concentration of the blood by changing excess glucose to glycogen. It controls the amino acid level by converting the excess into substances which can be oxidised to provide energy. By detoxifying potentially harmful substances that have been absorbed in the small intestine, the liver prevents their entry into the bloodstream. The liver prevents harmful levels of haemoglobin building up by removing and storing the iron from the haemoglobin molecule.
2. The liver makes bile, which helps the digestion of fats in the duodenum and intestine.
3. A large fluctuation in the concentration of solutes such as glucose could upset the osmotic equilibrium of cells. If hormones were allowed to build up they could adversely affect the ways cells function. Large variations in plasma proteins could affect the clotting processes.

Page 107

1. Enzymes are proteins. When proteins are heated above about 50^{o}C they are denatured and lose their shape. Boiling destroys the activity of an enzyme and this makes it a good experimental control.
2. The cloudiness is due to solid particles of egg white. When they are digested to soluble substances, the cloudiness disappears.
3. You could prepare a series of test tubes as in tube C and put them in controlled temperature water baths from say, 5^{o}C to 35^{o}C to see which one cleared first.
4. The variables are (a) the presence or absence of hydrochloric acid (tubes A and C), and (b) the presence or absence of unboiled pepsin (tubes C and D). (a) Tube A could be the control; (b) tube D could be the control.
5. Starch is a carbohydrate. It could not be an enzyme. A knowledge of the molecular structure of starch (p.12) reveals that it is made up of a chain of glucose molecules so it is the more likely source of glucose.
6. This question depends on personal data, so no general answer can be given.

Chapter 12 The blood circulatory system

Page 109

1. **a** White cells can vary their shape. They have a nucleus. They do not contain haemoglobin.
   b They are an important part of the immune system They can produce antibodies which combat foreign substances which get into the bloodstream. Some of them can ingest bacteria or damaged cells and other unwanted particles. White cells do not carry oxygen.
2. The lungs.
3. In all the living, respiring cells of the body.
4. If oxyhaemoglobin was a stable compound it would not readily break down to release its oxygen where needed.
   If a diet is deficient in iron an adequate supply of haemoglobin cannot be produced. Cellular respiration would be reduced and the person would be anaemic.

Page 111

1. **a** Both ventricles pump blood into the arteries.
   b The bicuspid, tricuspid and semi-lunar valves prevent blood flowing the wrong way.
2. **c** Atria contract.
   e Blood enters ventricles.
   b Ventricles contract.
   g Tri- and bicuspid valves close.
   a Blood enters arteries.
   f Semi-lunar valves close.
   d Ventricles relax.
   (You could start with **d**).
3. **a** The ventricles have to pump blood all round the body. The atria have only to pump blood into the ventricles.
   b The left ventricle has to pump blood all round the body (apart from the lungs). The right ventricle has to pump blood only to the lungs.
4. The pulmonary veins are not shown.
5. If the heart valves do not function properly, some of the blood in the arteries can flow back into the heart, so less blood is delivered to the body. This means that less oxygen reaches the muscle cells and this impairs vigorous activity.

Page 114

1. **a** Left Atrium.
   i Left ventricle.
   c Aorta.
   b Vena cava.
   f Right atrium.
   h Right ventricle.
   e Pulmonary artery.
   d Lungs.
   g Pulmonary vein.
2. The pulmonary artery carries deoxygenated blood.
   The pulmonary vein carries oxygenated blood.

3. **a** Veins return blood to the heart. Arteries carry blood away from the heart.
   b Veins are wider than arteries, less elastic with thinner walls and less muscle tissue. Some of them have valves in their linings.
4. **a** Capillaries have 'walls' only one cell thick compared with the thick, muscular walls of arteries and the thinner walls of veins. Capillaries are much smaller than veins or arteries. The capillary walls allow exchange of oxygen, carbon dioxide and digested food substances with the tissues.
   b Capillaries penetrate all the tissues of the body and supply them with food and oxygen. Arteries deliver blood to the capillaries and veins collect blood from the capillaries but do not exchange substances with the tissues.
5. Blood pressure is needed to circulate blood round the body. It is a normal function of a healthy blood circulatory system. Usually when people say they suffer from 'blood pressure' they mean a level of pressure which exceeds the normal range, i.e. 'high blood pressure'.

Page 115

1. Lymph consists of water, plasma proteins, salts (as ions), white blood cells and antibodies. The lymphatics leaving the alimentary canal may contain lipid droplets.
2. The fat molecule has not been digested to fatty acids and glycerol so it will enter a lacteal in a villus rather than a capillary. The lacteals empty their contents into lymphatic vessels which eventually join up to form a lymphatic duct. The duct empties its contents into the left subclavian vein which joins the vena cava before entering the left side of the heart. The left ventricle will pump blood round the body and some of it will reach the liver in the hepatic artery.
3. B lymphocytes ('memory cells') are retained in the lymph nodes. These cells produce antibodies which attack bacteria and other harmful cells. The spleen produces lymphocytes and antibodies. It removes bacteria from the blood. These are all immunological reactions.

Page116

1.	**a** gain	**b** lose
(i) Kidneys	carbon dioxide	oxygen, glucose, water, urea, excess salts
(ii) Lungs	oxygen	glucose, carbon dioxide, water vapour
(iii) Active muscle	carbon dioxide	oxygen, glucose

Page 120

1. The phagocytes ingest harmful bacteria, the lymphocytes produce antibodies which act against these bacteria.
2. The inoculation promotes the production of antibodies against a disease. The body is ready to 'fight' the disease organisms when they arrive.
   It is too late to do this once the disease organisms are present. The body will start making its own antibodies but it will take time for them to build up to an effective level.
3. **a** Examples of diseases controlled by active immunity are measles, mumps, rubella, diphtheria and flu.
   b An example of a disease controlled by passive immunity is tetanus.
4. The 'universal donor' is a group O person. The red cells have neither A or B antigens on their surface and cannot be clumped by anti-A or anti-B antibodies.
5. If a person's blood is clumped by the anti-B serum he could be group B or group AB. If the blood fails to clump in anti-A serum, he cannot be group AB and must be Group B.

Page 122

1. **a** Maintain a good level of regular exercise, reduce your stress levels.
   b Don't smoke, avoid an excess of fatty foods.
2. **a** If 95% of patients needing leg amputation are smokers there is clearly a correlation.
   b Smoking cannot cause leg amputation but it might lead to conditions in which amputation becomes necessary.
   c Smoking is one of the causes of atheroma. If the atheroma occurs in the leg and cannot be treated, it may necessitate amputation. (In fact there are many ways of treating atheroma in the leg. Amputation is necessary only in extreme cases).
3. **a** Vigorous exercise increases the demand for oxygen and glucose for the higher rates of respiration. These are met by increasing the blood flow which delivers these two substance more rapidly to the muscles.
   An increased respiration rate in active muscles produces CO_2 which is removed by the faster blood flow.
   The arterioles supplying the muscle will widen and so increase the amount of blood reaching the muscle. Increased ventilation in the lungs will hasten the supply of oxygen and the removal of excess CO_2.
   b Stored glycogen in the muscles and liver will be converted to glucose. Lipids will be released. The body temperature will rise leading to vasodilation in the skin and sweating (*See* p. 138).
   Levels of pyruvic and lactic acids may rise (*See* p. 20).
   c The raised heart rate will increase the blood flow to all parts of the body, not just the muscles.
4. The first injection stimulates the lymphocytes in the immune system to produce antibodies specific to the antigen in the vaccine. Some of the B lymphocytes are 'memory' cells. When the second injection is received, the memory cells reproduce very rapidly and raise the level of antibodies.