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Physical techniques for introducing DNA include biolistics (use of a gun to shoot the DNA), microinjection and electroporation, the use of an electric field to alter the permeability of the plant cell plasma membrane.

Chemical techniques for introducing DNA include calcium chloride, which increases the plasma membrane permeability and liposomes, closed vesicles composed of a bilayer.

Despite the small size of chloroplast genome compared to the nuclear genome, chloroplast DNA makes up as much as 10-20% of the total cellular DNA and contains about 130 genes. Uptake of transgenes into the chloroplast genome is achieved via homologous recombination. This is a type of recombination in which nucleotide sequences are exchanged between two similar or identical DNA molecules.

B2.9 Recombinant DNA can be introduced into whole plants, leaf discs or protoplasts

Introduction of recombinant DNA

Recombinant DNA can be introduced into whole plants, leaf discs or protoplasts. There are a variety of different methods by which the recombinant DNA can be introduced.

Whole plant

A DNA gun (*Figure 1331*) can be used to introduce transgenic DNA into the meristematic tissue of a whole plant as well as cells or callus. It has been especially useful in transforming monocot species like corn and rice.

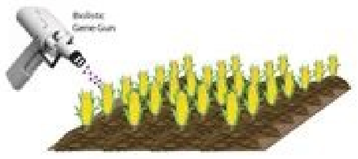


Figure 1331 A DNA gun

Leaf discs

The soil bacterium *Agrobacterium tumefaciens* is frequently used as a vector to introduce recombinant DNA via the use of leaf discs. A leaf disc is the circular piece cut from the lamina of a leaf. This cutting is done with a metallic or glass tube with a sharp edge.

These leaf discs are then incubated with the bacteria for a few hours. Shoots are formed from the transformed cells of the discs after they have grown for several weeks in a culture medium.

Agrobacterium methods are often used to infect plant embryos or even whole inflorescences (flowers): floral dip technique not just leaves.

Protoplasts

Plant cells are usually protected by a rigid cell wall comprised of cellulose that provides structural support for the plant. The cell wall can be digested away by an enzyme mixture containing the enzyme cellulase, thus producing membrane-bound protoplasts.

A variety of different transfection techniques, such as electroporation and microinjection, can then be used to deliver recombinant DNA plasmids into the protoplasts.

In addition, protoplasts isolated from different plants can be made to fuse together to form a hybrid which can then be regenerated into a whole plant. Hence, protoplast fusion allows useful traits from one plant to be incorporated into another plant despite large differences between the species. When either single or fused protoplasts are transferred to a culture growth medium, cell wall regeneration takes place, followed by cell division to form a callus which can form a plant.

B.2.10 Recombinant DNA can be introduced by direct physical and chemical methods or indirectly by vectors

Introduction of recombinant DNA

Physical Methods

Pronuclear injection

DNA can be introduced directly into an animal cell by microinjection. Multiple copies of the desired transgene are injected via a glass micropipette into a recently fertilized egg cell, which is then transferred to a surrogate mother.

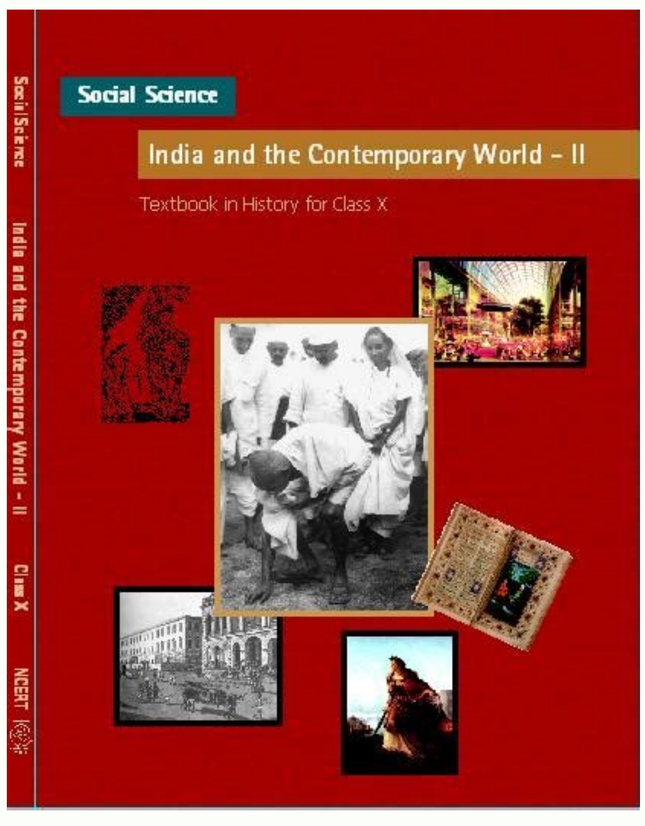
Transgenic mice and livestock are produced in this way, but the process is inefficient only 2 - 3 % of eggs give rise to transgenic animals and only proportion of these animals express the added gene adequately. This method is used to produce sterile GM insects, of increasing interest in controlling insect borne diseases.

Microinjection can also be used with plant cells but it is more difficult due to the presence of the cell wall.

OPTIONS

4D Biodiversity

Name:.....



Exploring chromosome 21 in databases

Chromosomes, for example human chromosome 21, can be explored in databases such as 'Ensembl'.

The Ensembl database (***Figure 1364***) was launched in 1999, shortly before the completion of the human genome project. It is aimed at molecular biologists studying the human genome and other vertebrates and model organisms, for example, Drosophila.

Chromosome 21 in humans is the subject of intense research. Trisomy of chromosome 21 causes Down's syndrome. Chromosome 21 is the smallest human chromosome representing about 1.5% of the total DNA in cells. It contains about 300 to 400 genes. A number of diseases are related to genes on chromosome 21, including Alzheimer's disease and a number of syndromes and several types of leukemia.

Ensembl is a genome browser and generates graphical views of the alignment of genes against a reference genome or reference chromosome (***Figure 1365***). These are shown as data tracks and allow the user to zoom to a region or move along the genome or chromosome. Pseudogenes are non-functional relatives of genes that have lost their protein-coding ability and are no longer expressed; long stretches of GC rich regions are often associated with genes. A non-coding mRNA does not result in a protein product but the resulting RNA may play an important gene regulatory function.

Figure 1364 the Ensembl database

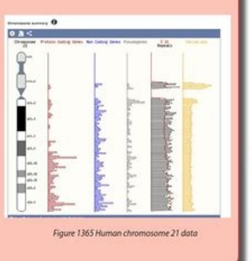


Figure 1365 Human chromosome 21 data

International cooperation

An important aspect to science is cooperation and collaboration between groups of scientists. This may involve scientists from different disciplines within the same institution, or may involve scientists from different institutions in different countries.

On-line databases on the Internet and numerous international conferences allow scientists to access and share information related to DNA and protein sequences. Most of the on-line is open access and open to all users, but some data is only accessible by researchers.

OPTIONS

Chapter 4 Video Review

Crash Course – 5 Human Impact on the Environment

Crash Course – Pollution

The Sci Show – Invasive Species

Bozeman Biology – Human Impact on Earth System

Bozeman Biology – Global Climate Change

We're sorry, but WorldCat will not work without JavaScript enabled. Please enable JavaScript in your browser. Peter Kariuki, James Okumu, Lydia Njeru, Zedekiah Okwania Biology Today is a new biology series specifically designed to fully meet the objectives of the secondary school biology curriculum. The series was developed by a team of teachers with extensive experience in teaching and testing biology. Biology Today's Student Book 4: Written in simple, easy-to-understand language. It is heavily illustrated to help students understand the concepts. It emphasizes news in biology to keep the student informed of the latest discoveries and advances in the field. It includes well-designed hands-on activities that enable the student to successfully perform hands-on activities and provide accurate references. Contains full-color photographs introducing the student to the study of photographic specimens. It contains fascinating and inspiring stories from leading scientists. An exam guide is provided at the end of each topic to help the student connect the topic content to the exam scenario. There is also a strategy book for each level. ISBN: 9780195742749 Code: 2010105000294 Free shipping on orders over 2000 KSh This product has not yet been rated. Add your review © 2022 Text Book Center Ltd. Made by Regulus. Glomeruli 13.1. Homeostasis and renal tubules 13.1.1. Explain the meaning of homeostasis. 13.1.2. It justifies the necessity of maintaining physical and chemical factors in the internal environment. 13.1.3. Describe the involvement of various organ systems in maintaining an optimal internal environment. 13.1.4. Apply knowledge of the concept of homeostasis by regulating: â¢ body temperature â¢ blood glucose levels â¢ partial pressure of carbon dioxide â¢ blood pressure 13.2 urinary system 13.2.1 determine the structure and function of the kidneys. 13.2.2. Drawing, annotation andConstruction of nephron and collecting ducts. 13.2.3 Describe the formation of urine: • ultrafiltration • reabsorption • secretion 13.2.4 Summarize the concept of homeostasis using the negative feedback mechanism of osmoregulation. 13.2.5 Carry out an experiment to determine the effect of varying amounts of water intake on urine production. 13.3 Health problems related to the urinary system 13.3.1 Describe the health problems related to the urinary system. 24513.1 Homeostasis Homeostasis Homeostasis is the regulation of physical and chemical factors of the internal environment within normal limits so that the cell functions under optimal conditions. Physical and Chemical Factors of the Indoor Environment Physical factors to control include temperature, osmotic pressure, and arterial pressure. The regulatory values of the chemicals that need to be regulated are pH value, mineral concentration and blood sugar concentration. Increases d value w value Any deviation from the normal range triggers a homeostatic mechanism that involves negative feedback. Homeostasis regulates the normal, homeostatic, normal internal environment so that it is in a constant state, even when the external environment varies greatly. This ensures that cellular activity continues to function at an optimal level. in Fig. Figure 13.1 shows a negative feedback mechanism that increases regulatory value and homeostasis. FIGURE 13.1. A deviation from the normal range triggers (b) a factor that falls below the normal range is a homeostasis mechanism that returns that factor to normal. value increased to normal range to normal range Organ system involved in maintaining an optimal internal environment In the body, various organ systems function and interact with each other to maintain an optimal internal environment. ¢ Body temperatureIntegumentary system (skin and sweat glands), nervous system, circulatory system, muscular and endocrine system. • Blood sugar levels are regulated by endocrine glands, the circulatory system and the digestive system. • The partial pressure of carbon dioxide in the blood is regulated by the respiratory system, the circulatory system, and the nervous system. • Blood pressure is regulated by the circulatory and nervous systems.246 13.1.1 13.1.2 13.1.3 Body temperature regulation Maintaining body temperature within a fixed range is important for enzyme-catalyzed cellular metabolic reactions to occur at optimal levels. Too high temperatures denature enzymes, too low temperatures slow down the metabolic activity of cells and disrupt cellular processes. These changes in body temperature are sensed by thermoreceptors in the skin and hypothalamus. Figure 13.2 shows the regulation of body temperature by various effectors when body temperature exceeds normal limits. Figure 13.3 shows the regulation of body temperature by various effectors when body temperature drops below normal. Body thermoreceptors in the hypothalamus Hypothalamic temperature detected (temperature rises through thermoreceptors in the switching center of the skin) Normal ranges Pituitary Body temperature regulation effectors using physical methods Muscle rectifiers Fine hairs Arterioles during heat transfer through the epidermis Less stimulated, skin shrinks, epidermis expands, narrows no (vasodilation) (skin) and the skin surface, so finer hairs reduce blood flow to the skin arterioles and smooth the skin surface. the surface expands. As a result, the muscles relax, more heat is lost, a thin layer of air enters the external environment between the thin hairs. radiant heat. Can be released quickly. Skeletal muscles Sweat glands are stimulated to producemuscles sweat. Heat is absorbed to contract and relax, sweat evaporates and it cools less. The body does not shake. skin. Regulation of Body Temperature Effectors by Chemical Methods CHAPTER 13 Adrenal Glands Are Adrenal Glands The thyroid gland is not stimulated by laryngeal secretion, and adrenaline secretion is stimulated. The rate of thyroxine metabolism is reduced. Thyroid gland goes down. Metabolic rate decreases. Screw connection No excess heat. Trachea 13.2. FIGURE Body temperature regulation when temperature rises 24713.1.4 Body thermoreceptors in the hypothalamus Temperature falls below the normal range recognized by the hypothalamus Thermoreceptors in the skin (temperature control center) Pituitary Body temperature regulation effectors by physical methods Epidermis (skin) Erectile muscles Arterioles Arterioles are stimulated, so stimulated raised skin. Erector (vasoconstriction). A thick layer of air-enclosed muscles. As a result, less blood than skin flows between the fine hairs to the surface, which acts as an insulator. Prevents heat loss, less heat is lost through skin to skin. external environment with radiation. Skeletal muscles contract and sweat glands relax, causing the body to shiver. She is not stimulated. gswlapkeneealdleutnhjar generates heat, which in turn increases body temperature because there is no sweating. Muscle contraction requires skeletal muscle energy. Regulation of body temperature by effectors using chemical methods. The adrenal glands are the adrenal glands. This hormone, more thyroxine, accelerates the conversion of glycogen to glucose in the metabolizing gland. Evaluation. More heat means an increase in the metabolic rate of the trachea. created for the body.Glucose oxidationheat to warm the body. 13.3. PICTURE. Regulation of body temperature during hypothermia248. Blood sugar regulation. Malaysian innovation. The pancreas is responsible for maintaining blood sugar (glucose) levels. According to scientific studies, the sugar level is within the normal range from 75 to 110 mg/100 ml. Langerhans cells confirmed that the pancreas constantly produces and secretes insulin and glucose. Cinnamon can enter the bloodstream to help regulate blood sugar. Action on both blood sugar levels. These hormones and the homeostasis mechanism work together to keep blood sugar within normal limits, as shown in Figure 2. 13.4. Increase in blood sugar (after meals) Pancreas Decrease in blood sugar (between meals) Pancreatic beta Langerhans cells (Î²) Pancreatic alpha cells (Î±) stimulate insulin secretion Langerhans cells stimulate blood circulation. release glucagon into the blood. Insulin stimulates the liver. Glucagon stimulates the muscle cells of the liver to use the cells to convert glycogen into glucose in the glucose production process of fat cells. cellular respiration. negative • Glucagon also promotes... Insulin stimulates a feedback loop: the breakdown of fat and the conversion of excess released fatty acids, which converts glucose into glycogen, so blood sugar is metabolized, produced, stored in the liver, and returned to normal energy. Muscle cells. CHAPTER 13 In fat cells, insulin turns excess glucose into fat. 13.4. FIGURE Blood sugar regulation Lack of insulin production, secretion, and uptake by ICT 13.1 target cells can lead to diabetes. Blood sugar levels in diabetic patients are usually high and unstable after meals. The patient also has thirst, tiredness, fatigue and weight loss. In healthy people, diabetes can be controlled with insulin injections, blood sugar-lowering pills, and proper diet. and diabetics (from August 2113.1.4 249 Our World of Biology Regulation of Blood Carbon Dioxide Partial Pressure in Noni Fruit (Morindacitrifolia) Breathing is believed to be an involuntary act regulated by the respiratory system to lower the control center in the medulla oblongata. Respiratory control center, high blood pressure. helps maintain homeostasis by controlling the partial pressure of carbon dioxide released from blood dioxide (Figure 13.5). During the frenzy, this fruit was sold in large quantities. activity, partial pressure of carbon Carbon dioxide is dissolved in blood plasma to dioxide, which rises from carbonic acid. Carbon dioxide is broken down into hydrogen ions and bicarbonate ions by cellular fluff. breath. Carbon + water Carbon hydrogen + bicarbonate dioxide acid ions Blood and tissue pH value baroreceptors carotid body fluid that floods the brain in the carotid artery (cerebrospinal fluid). Carotid Artery Respiratory Control Center and Nerve Impulses These pH changes in the aorta, the circulatory system, are caused and sensed by the central arc control center, which is sent by a chemoreceptor to a baroreceptor in the medulla of the aortic arch. (chemically sensitive sensory cells) carotid and peripheral chemoreceptors (carotid body and aortic body) (Fig. 13.6). 13.6. FIGURE Aortic body, carotid body, and baroreceptor medulla Intercostal muscle impulse Intercostal muscles, respiratory rate, heart Diaphragmatic partial pressure and respiratory rate, ventilation Increased carbon dioxide and myocardial velocity. This blood pH contracts and relaxes, causing the carbon to quickly return to normal. gaseous dioxide is expelled from the lungs. Diaphragm 13.5. FIGURE The process of regulating the partial pressure of carbon dioxide in the blood 250 13.1.4 Mechanism of blood pressure regulation Baroreceptors or pressure receptors are located in the aortic arch and carotid artery (Fig. 13.6). Sleep ateriais the carotid artery that supplies blood to the head. These receptors sense the pressure of the blood flowing through them and constantly send impulses to the cardiovascular control center in the spinal cord to regulate blood pressure (Fig. 13.7). exampleexample if during heavy vigorous activity.bleeding. Baroreceptors in the aortic arch Baroreceptors in the aorta and carotid arteries are stimulated. the arch and carotid artery are not stimulated. The cardiovascular control center in the medulla oblongata is stimulated by the constriction of the cardiovascular control vessels. The center in the medulla oblongata is less agitated. There is vasodilatation. This reduces the resistance... CHAPTER 13 arterial constriction occurs in the blood flow. It increases blood flow resistance. for blood circulation in blood circulation. There are weak heart muscle contractions. There are stronger contractions of the heart muscle. blood pressure drops Blood pressure returns to normal range. Blood pressure returns to normal range. Vasodilatation 13.7. FIGURE Regulation of blood pressure 13.1.4 25113.1 Formative practice 1 What does homeostasis mean? Explain how homeostasis occurs. 2 The employee had to work in the heat because the electricity was cut off in his office. Describe the effector response to body temperature regulation. 3 A doctor diagnosed a 40-year-old man as unable to produce enough insulin. Describe what happened to the man. 4 Ahmad has just finished a 100m race. Explain how his blood pressure returns to normal. 13.2. Urinary System The human urinary system plays an important role in homeostasis. The urinary system consists of the kidneys, ureters, bladder and urethra (Fig. 13.8). The function of the urinary system is to eliminate nitrogenous compounds such as ureathey regulate body fluid volume, blood osmotic pressure, ion concentration in body fluids, electrolyte content, and blood pH. Biological Lens Kidney Structure and Function Did you know that the kidney consists of a cortex and a medulla. Urine formed in the right kidney is where the kidney drains into the pelvis. Below the left Kidney performs two main functions: kidney? This difference in (a) excretion in position is related to (b) osmoregulation, the liver as an excretory organ removes toxic wastes (nitrogen at apex) such as urea, uric acid, ammonia and creatinine. the right kidney. As an organ of osmoregulation, the kidney controls: total water volume in body fluids, ion concentration in body fluids, blood osmotic pressure, i.e. concentration of solutes and volume of blood and body fluids; • content. pH of electrolytes and blood and body fluids252 13.2.1. renal artery ureter renal vein ureter tube bladder renal artery leads pelvis CHAPTER 13 oxygenated blood from the heart to the kidneys. 253 The renal vein carries deoxygenated blood from the kidneys back to the heart. Urine flows through the ureter into the cortex of the bladder. 13.8. FIGURE Cross-section of urinary system and kidneys 13.2.1. Urine Formation Three main processes are involved in the formation of urine: ultrafiltration, reabsorption and secretion. NEPHRON • Each kidney consists of millions of functional units called nephrons (Fig. 13.9). Each nephron consists of the following structures: Bowman's capsule Renal tubule Bowman's capsule is cup-shaped and contains a collection of capillaries called glomeruli. The glomerulus arises from an afferent arteriole that branches off from the renal artery. The glomeruli rejoin to form an efferent arteriole. Renal tubules consist of the proximal partTubules, loop of Henle and distal convoluted tubule. • The loop of Henle is a long U-shaped tubule that extends to the renal medulla. The distal convoluted tubule of several nephrons opens into the collecting duct. â¢ Formed urine flows from collecting duct to ureter blood flow indicator: H2O blood flow glucose, amino acid afferent arteriolar flow filtrate urea passive transport renal vein glomerulus active transport efferent arteriole osmosis 1 distal convoluted tubule Hintik: s Clâ Clâ Na+ Aliran capsule Na+ Aliran Penga filtrate out 2 Renal fluids 4 Peng Glomerulus Osmoral artery Processed NaCl filtrate from other nephrons H2Ocortex Proximal glycoconvoluted tubule Blood collection Urea K+5 Urea Ureter K+5 3 Network Na+ Clâ 13.9. FIGURE Nephron Structure and Urine Formation 254 13.2.2 13.2.31 ULTRAFILTRATION IN BOWMAN'S CAPULUS Blood entering the glomerulus is under high hydrostatic pressure because the arteriole has a larger diameter than the afferent. Efferent arteriole diameter. This pressure causes ultrafiltration, i.e. fluid is absorbed through the walls of the glomerular capillaries into the lumen of Bowman's capsule. The fluid that enters Bowman's capsule is called the glomerular filtrate. ¢ Glomerular filtrate has the same composition as blood plasma, but does not contain red blood cells, platelets and plasma proteins. â¢ Red blood cells and plasma proteins remain in the blood flowing into the efferent arteriole because the size of these substances is too large. large to be reabsorbed by the glomeruli.2 REABSORPTION IN THE PROXIMAL TUBULESâ¢ Reabsorption of the glomerular filtrate occurs along the renal tubules. Dissolved substances enter the network of blood capillaries through the walls of the renal tubules. â¢ In the proximal convoluted tubule, sodium ions (Na+) are actively pumped into the blood capillary network andIons (Cl) are passively absorbed. 100% of glucose and amino acids are also reabsorbed by active transport. Filter, but increases the concentration of dissolved substances in the blood capillaries. As a result, water enters the blood capillaries by osmosis.3 REABSORPTION IN THE LOOP OF HENLE AND THE DISTAL CONSTRUCTION TUBE In the loop of Henle, water is reabsorbed by osmosis. Sodium ions are reabsorbed by active transport. More water, sodium, and chloride ions are reabsorbed in the distal convoluted tubules. The amount of water and salt absorbed depends on the amount of water and salt in the blood. URINE FORMATION CHAPTER 13 Secretion is the process of secretion. • When the renal fluid reaches the collection site for non-ductal waste products in the blood, only a small amount of salts that have previously been filtered out in the renal tubules remain. and most of the water is reabsorbed into the bloodstream." This process is the opposite of absorption. • The remaining kidney fluid is now called urine and drains through the collecting tubes. • Secretion occurs along the renal tubules and it is here that a small amount of urea diffuses through the collecting ducts, but is most active when released into the surrounding fluid. and distal convoluted blood tubules. capillaries due to their small molecular size. Secretion occurs by simple diffusion. Urine contains water, urea, salt NaCl, urinary and active transport. acid and creatinine. Excreted substances include: • After leaving the collecting ducts, urine passes hydrogen ions (H+), potassium ions (K+) through the ureter, bladder, urethra, and ammonium ions (NH4+), urea, creatinine, and is finally excreted from the body. toxic substances and some drugs. The secretion removes toxins and helps regulate blood ion levels. 13.2.2255Mechanism of homeostasis and osmoregulation The water content in the body is constantly changing depending on food and drink intake. Osmoregulation is the process of regulating the level of water and salt in the body so that the osmotic pressure of the blood can be maintained at a normal level. Osmoregulation is achieved by regulating the volume of urine produced by the kidneys. Figure 13.10 illustrates the osmoregulation of blood osmotic pressure. NORMAL OSMOTIC PRESSURE Drinking too much water. Drinking too little water or losing water due to vigorous activity.1 Blood osmotic pressure falls below the normal range. 1 Blood osmotic pressure rises above the normal range. 2 osmoreceptors in the hypothalamus are less stimulated. 2 osmoreceptors in the hypothalamus are stimulated. 3 The pituitary gland is less stimulated. As a result, less ADH is released from the pituitary gland. Rather, the pituitary gland. ADH is secreted by the pituitary gland.4 Low levels of ADH make the walls 4 High levels of ADH make the distal convoluted tubule and the collecting walls of the distal convoluted tubule and duct less permeable to water. the collecting duct becomes more permeable to water.5 Less water is reabsorbed from the renal fluid into the capillaries. 5 More water is absorbed from the renal fluid into the capillaries. 6 Less concentrated urine is produced in large quantities. 6 The result is urine that is highly concentrated and has a small volume. 7 Osmotic blood pressure returns to normal. FIGURE 13.10 Osmoregulation of blood osmotic pressure 256 13.2.4 To better understand how drinking different amounts of water can affect urine production, do the following exercise: 1.2 13.1 Activity A Explore the effects of drinking different amounts of water. volume of urine excreted? Hypothesis The more water is consumed, the higher it isurine is produced. Variables: Manipulations: Amount of water consumed Response: Amount of urine collected Constants: Type of drink, age of student, and time interval for urine collection Sample Consider! chilled, having approximately the same mass. Equipment Glass, urine collection glass, stopwatch and measuring cylinder. Procedure 1 Students are not allowed to eat or drink after midnight the night before the experiment. 2 Students are divided into four groups depending on the average weight. 3 Students must urinate before starting the experiment. 4 Each student should drink the following amount of water: (a) Group 1: drink 250 ml of water (b) Group 2: drink 500 ml of water (c) Group 3: drink 750 ml of water (d) Group 4: drink 1000 ml of water. 5 During the experiment, students should be calm and not perform strenuous activities. 6 Collect and measure each student's urine at 20, 40, and 60 minutes. 7 After measuring urine, it should be flushed down the toilet. 8 Record the average amount of urine collected at each time interval for each group in the table below. 9 Count the total amount of urine excreted in each group. Results Amount of water Average amount of urine collected CHAPTER 13 Total amount of urine consumed (ml) (ml) produced (ml) Group 250 20 minutes 40 minutes 60 minutes 1500 2750 31000 413.2.5 257 Discussion 1 What is the relationship between the amount of water consumed and the amount of urine produced? Explain your answer. 2 How does the amount of urine change over time? 3. Explain the difference between the amount of urine collected from a person who drank 100 ml of distilled water and a person who drank 100 ml of 5% sodium chloride solution. Conclusion Is the hypothesis accepted? Give an appropriate conclusion. Act1iv.i2tyit1i3vi.t2kA Summarize and discuss information about the hemodialysis collection.Reference Materials Procedure 1 In groups of four, conduct some hemodialysis studies. 2 Discuss the following. a) Study the causes of renal failure for which a person is undergoing hemodialysis. b) Explain how hemodialysis works. 3. Write a report of your findings and present it to the class. 4 You can also raise funds for hemodialysis centers through campaigns to raise awareness of the importance of helping patients who need treatment. Discussion 1 Why would anyone need hemodialysis? 2 How does hemodialysis work? 3 How does this affect patients not receiving treatment? 13.2. Formative Practice 4 A person has kidney damage. 1. In which part of the kidney should one undergo hemodialysis? Suggest the steps for this proximal convoluted tubule, subject of loop of Henle, to find the distal convoluted tubule? easily through your everyday life. 2 Suggest two possible measures that can make the walls of the collection channel more permeable to water. 3 Describe how Na+, water and glucose are reabsorbed in the proximal convoluted tubule.258 13.2.513.3. Urinary Tract Problems Kidney failure can be caused by illness, bacterial infection, or accident. Diabetes is the leading cause of kidney failure, followed by high blood pressure. Both conditions damage the glomeruli. In addition, some people may face the problem of kidney stones. Kidney stones are hard masses of uric acid, calcium oxalate, or crystalline calcium phosphate. ICT 13.2. Action: Gather information and discuss urinary health issues. Kidney stones can block the ureter and reduce urine production. To reduce the risk of kidney stones, drink plenty of water every day. Why? Kidney stones 13.11. FIGURE Formation of kidney stones in the kidneys 1313.3. CHAPTER Formative Practice 2. Give two reasonsthe person will have kidney stones. 1 Azman suffers from kidney stones. Explain the effect of kidney stones on his health. and kidney stones in normal kidneys for cells to function at optimal levels salts in the body - nephron consists of Bowman's capsule body temperature regulated by the glomerular dermis, the proximal system, the nervous system, the convoluted tubules, the loop of the circulatory system , the muscles Henle and distal convolute system and tubules of the endocrine system Blood glucose levels The process of urination Regulated by the endocrine system, the circulatory system and • ultrafiltration digestive system • reabsorption • secretion by carbon dioxide partial pressure in the blood homeostasis mechanism is regulated by the respiratory , Osmocular System • Blood Osmoregulation Nervous Osmotic Pressure Our System Arterial Pressure Regulated by the System Circulatory and Nervous System260Self Analysis Do you master the following important concepts? • The importance of homeostasis • The need to maintain physical and chemical factors in the internal environment • The involvement of different organ systems in maintaining an optimal internal environment • The concept of homeostasis in regulation • The structure and function of the kidneys ¢ The structure of Das Nephron and the collecting ducts ¢ The process of urine formation ¢ The concept of homeostasis and negative feedback in osmoregulation ¢ Urinary health issues General Practice 13 1 In what part of the kidney is loop of Henle located? 2 Indicate the state of the urine excreted by a person after (a) drinking a lot of water (b) eating too much salty food. 3 Provide a test thatmade in a laboratory to determine if a person has diabetes. CHAPTER 13. 4. Explain the role of the liver when blood sugar levels drop. Table 1 shows the concentration of amino acids in blood plasma and urine. TABLE 1 Contents Concentration in blood plasma entering the kidneys (g per 1000 ml) (g per 1000 ml) amino acids 85 0 261(a) Explain the differences between amino acid concentrations in blood plasma and urine. b) The patient has damage to both kidneys. This condition causes an imbalance of water and an accumulation of urea in the blood. Describe the effect of renal failure on the regulation of blood water management. 6 (a) The patient had a disease requiring the removal of the pancreas. Explain the effect of removing the pancreas on the production of enzymes and hormones, and then on digestion and blood sugar levels in humans. (b) What advice can be given to the patient to help him cope with the health problems caused by the removal of the pancreas? 7 Figure 1 shows the structure of the nephron and the collecting duct. J FIGURE 1 (a) Name the process that takes place in J. b) Name two substances that are not filtered by the glomerulus. (c) Explain how the process described in (a) works. (d) Explain why the fluid in the loop of Henle does not contain glucose, although Bowman's capsule does. e) Mammals have different kidney structures depending on the presence of water in their environment. The concentration of urine output depends on the length of the loop of Henle. The longer the loop of Henle, the greater the salt concentration in the fluid surrounding the loop of Henle. Based on this information, what can you predict about the loop of Henle in animals living in a humid environment compared to animals living in a dry environment? regulates 6 hours 9 breathingan involuntary process controlled by the respiration control center in the medulla oblongata. Explain what happens to a climber's breathing rate when he is on top of a high mountain. 10 Explain the role of erectile muscles, fine hair, and sweat glands in maintaining body temperature in hot weather. 11 (a) (i) Explain the importance of maintaining a body temperature of

37°C. (ii) Describe two physical responses of the body to regulating body temperature after a cold water bath. b) How do you think it affects diuresis if the food you eat is high in protein? c) Explain how the pituitary gland regulates the osmotic pressure of the blood when a person does not drink enough water. Extension 12 Explain how marine fish can survive without dehydration. 13 Why is a urine test used to determine if a person has used drugs? 14 Modern technology has greatly helped patients with kidney problems. For example, hemodialysis machines have helped many patients with kidney failure survive. Research is currently underway to produce bioartificial kidneys. It is believed that this device can perform all the functions of a healthy kidney. What properties do you think a bioartificial kidney should have in order to function like a real kidney? Full answers can be obtained by scanning the provided QR code. 263KKPTEL Hall and Bewegung bei Menschen und 14 Tieren ä gHHtWhrooehwswahstdhduuonorpefahlpsnutehhmsr.eskabtemniyrlepodaestvsm,sel w?ssoyofastjmomtedimmtlesa?pnfsodummodvion?o14.1 Types of Skeletons 14.4 Health Issues Related to the Human Musculoskeletal System 14.1.1 List the types of human and animal skeletons: 14.4.1 Describe health problems the human musculoskeletal system • hydrostatic skeleton • exoskeleton • endoskeleton • osteoporosis 14.1.2. Rationale for the need for a skeleton • osteomalacia • rickets in humans and animals. • arthritis • scoliosis 14.2. Human musculoskeletal system 14.4.2. Justification of maintenance methods 14.2.1. Determine the bones that make up the musculoskeletal system of a healthy person: system. • axial skeleton • additional skeleton 14.2.2. Discuss the types of vertebrae in the spine: • cervical vertebrae (including axial and axial vertebrae) • thoracic vertebrae • lumbar vertebrae of the sacral spine • tail vertebrae 14.2.3. Compare and compare types of vertebrae. 14.2.4 List the types of joints in the human skeletal system: • fixed joints • stiff joints • free-moving joints 14.2.5. Draw, label and explain the structure of the hinged joint of the human forearm: • bones • cartilage • skeletal muscles • tendons • ligaments • synovial membrane • synovial fluid 14.3. Movement and movement mechanism 14.3.1. Explain the mechanisms of movement: • human legs (walking) 14.3.2 Briefly describe animal locomotion mechanisms 263141 14.1 Types of skeletons: exoskeleton, endoskeleton, and hydrostatic skeletons Types of Skeletons ICT 14.1 Exoskeleton Endoskeleton Hydrostatic Skeleton Activity: Brainstorming Need for skeletal systems due to animal and human needs Support and locomotion in humans and animals Humans and animals need a skeletal system to move from place to place in search of food, companions or to escape from Brainstorm! predators and threats. Thus, most multicellular organisms need support due to their soft body and tissue benefits. Insect and crabs exoskeleton provides support and protection of the body and allows these animals to move. Animals with soft tissues, such as earthworms, require a hydrostatic skeleton to maintain a rigid exoskeleton-like body shape. An endoskeleton to maintain the body shape of insects? supports the soft tissues of the body and protects the internal organs from damage. In the next chapter, you will learn more about the human skeletal system. Human endoskeleton 14.1. Formative practice 1. Why do organisms 3. need to retain their body shape in moving animals? Bodies, what's the use of legs under the body? 2 Name two functions of the skeleton system (eg rats) compared to humans. Do you have legs on the sides of your body (like a crocodile)? Hydrostatic skeleton of the earthworm exoskeleton of the grasshopper266 14.1.1 14.1.214.2 Human musculoskeletal system Skeletal system The human skeletal system consists of the axial skeleton and the caecum skeleton. Axial Skeleton The axial skeleton consists of the skull, spine, ribs, and sternum (breast bone). The appendicular skeleton includes the shoulder girdle, pelvic girdle, upper and lower limbs. Skull Indicator: Axial Skeleton Accessory Skeleton Sternum Clavicle Thorax Lumbar Scapula Rib Humerus Ulna Ilium Upper Limb Radius Pelvic Girdle Wrist Pubic Metacarpal Seventh Phalanx Hip Brainstorm to explain the different parts of the spine that vary in size and shape (Fig. 7.1).). Animals have a spinal cord. nerve channel. Cervical vertebrae Dorsal process Transverse process Nerve canal facet (articular facet (attached to ribs)above) middle 14.2. FIGURE Thoracic vertebrae Thoracic vertebrae (Figure 14.2) Thoracic vertebrae have a long spine Developmental and transverse processes serve as attachment points for muscles and ligaments Transverse processes (except for the 11th and 12th chest walls) have vertebrae. articulation ribs. spinous process Lumbar vertebrae (Figure 14.3) Transverse neural- The largest and strongest canal process of the vertebral bodies - They have a short spinous process Lumbar vertebrae - they have a large body, so the vertebrae carry the weight of the lower back 14.3. FIGURE Lumbar process from vertebrae for articulation Victim vertebrae (Fig. 14.4) with the last lumbar Five vertebrae fused together vertebrae forming a triangular bony transition for the caudal vertebrae (Fig. 14.4) Sacrificial nerves and blood Four bones fused together to form the tail vessels. is a triangular structure shown at one end. tail vertebrae 14.4. FIGURE Sacral and caudal vertebrae 14.2.2268 transverse spinous process atlas vertebra (Fig. 14.5) neural canal process • First cervical vertebra. facet • The vertebra has a large neurovertebral canal, a small spinous process, a pair of transverse foramen-axial transverse vertebrae 14.5. FIGURE Atlas vertebra (singular: foramen), but with the night opening of the cervical vertebrae. The vertebra attaches to the skull. Axial vertebra (Fig. 14.6) nerve arch spinal outgrowth nerve canal • Second cervical vertebra. Axial vertebrae have a large spine, a small transverse process, and a pair of transverse foramina. It has a dental process that attaches to the wall of the neural canal of the atlas vertebra. transverse spinous process alveolar process transverse process neural canal 14.6. FIGURE Transverse axial vertebra Cervical vertebrae (Fig. 14.7) foramen It has a short spinous process, a small shaft, a middle transverse, a broad transverse process, a short transverse process, and a pair. spinal processesforamin. 14.7. IMAGE. Cervical vertebrae, can you compare and contrast the different vertebrae based on the features shown? What are the differences between lumbar and thoracic vertebrae? What features are found in cervical vertebrae but not in other vertebrae? SIMILARITY BETWEEN VERTEBRAES All vertebrae have spinous and transverse processes, a center (except for the atlas vertebra), and a neural canal. Differences between the vertebrae Chapter 14 ¢ Short dorsal process â ¢ Long spinous process â ¢ Short spinous process ¢ Broad and short transverse process â • ¢ Long transverse process â ¢ Small transverse process Large median • ¢ Short median transverse process • Pair of transverse foramen • No transverse foramen • No transverse foramen 14.2.2 14.2.3 269Field of activity How are these bones assembled to form the skeleton? Bones are too stiff to bend without breaking. Flexible connective tissue forms the joints. Separate the chicken holding the bones together to allow for movement. In the next part, let's follow up on the different types of joints. Joints Joints are the points where two or more bones or cartilage and bone meet. Most joints allow the bones to move relative to each other. Different types of joints allow for different types of movement. Joints are classified into three types, namely â¢ immovable joints (e.g. cranial sutures) (Fig. 14.8) â¢ easily movable joints (e.g. intervertebral discs and intervertebral cartilages). first rib and sternum) (Fig. 14.9) • freely moving joints (e.g. hinge and ball joint) (Fig. 14.10) clavicle sternum first rib suture suture disc 14.8. FIGURE Fixed Articulated Vertebra 2140. FIGURE 9. Slightly Movable Joints 14.2.4. Freely moving joints. The ball joint isexample of movable joints that allow free movement. The general structure of a freely movable joint and the function of its parts are shown in Fig. 14.10. The capsule is the fibrous bony tissue that surrounds and protects the joint. Cartilage serves as a cushion for the joint, absorbing shock and reducing friction between the ends of the bones. Cartilage also protects bones from wear and tear. The synovial membrane secretes synovial fluid into the synovial cavity. Synovial fluid acts like bone PHOTO 14.1 A joint lubricant that reduces the friction of the pelvic girdle between the ends of the bones. femur FIGURE 14.10 Freely movable joint BALL JOINT The acetabular joint allows rotation in all directions (Figure 14.11). Allows the arm and leg to perform circular movements. Examples of ball-and-socket joints are the shoulder joints between the humerus and the pectoral girdle and the hip joint between the femur and the pelvic girdle. FIGURE 14.11 Hinge in the femur HINGE CHAPTER 14 sagittal The hinge allows the bones to move in the same plane 14.2.4 (Fig. 14.12). For example, the knee joint allows the lower leg to swing back and forth like a door hinge. The articular joint can also be found in the elbow joint and the phalanges of the fingers and toes. tibia FIGURE 14.12 Articulated knee joint 271 In addition to joints and bones, it depends on skeletal muscles for support and movement, including skeletal muscles, tendons, and ligaments. skeletal muscle humerus skeletal muscle tendon synovial • Consists of bundles of muscle fibers with a large radius sheath nerves and vessels elbow synovial cartilage • Muscles work in pairs and work in opposite directions FIGURE 14.13 Skeletal muscles, directional fluids, ie. contracts, the tendon and ligamentous-ligamentous apparatus of the other relaxes and vice versa. These types of muscles are known as antagonist muscles. Biceps and triceps are examples of antagonistic muscles. ProtractorWhen it contracts, it is called an extensor. For example, triceps. The muscles that bend the limb during contraction are called flexors. For example, biceps. Tendons (connects to bones and muscles) â¢ Consists of strong fibers, not flexible, but flexible. STEM Bulletin Ligament (connects bone to bone) Electroactive Plastics • Bones in joints contain ligaments made of a polymer used to form strong, flexible, rigid bundles of connective tissue. They produce synthetic muscle mass. The plastic is â¢ The ligament provides support and strength to the joints and allows them to bend at the joints while the bone forms. humanoid robots and allow the robots to walk 14.2 Formative Exercise. A synthetic muscle contracts 1. Name the bones of which State 3 marks the differences between electrical current response, current structure, and function of the axial skeleton. The human body is also used. tendons and ligaments. to help those with missing limbs. 2 Explain the function of cartilage 4 Explain the differences and synovial fluid in a joint. between the ball and socket joint.14.3 Movements and locomotion The movement mechanism of the human forearm includes the biceps and triceps. 14.14. the figure shows the action of two antagonist muscles that cause movement of the forearm.272 14.2.5 14.3.1 ARM STRENGTHENING ARM STRENGTHENINGâ¢ When the biceps contracts, the pulling force is â¢ When the triceps contracts, the pulling force is transmitted. through the chord to the radius. transferred to the ulna through the tendon. â¢ At the same time, the triceps relaxes. â¢ At the same time, the biceps relaxes. â¢ The radius is pulled up, causing the arms to be pulled down, straightened, and flexed. Poor. Scapula Tendon Biceps Tendon Loosened Biceps Tendon Torn Triceps Contracted Triceps Radius Loosened Humerus Ulna Tendon Elbow JointMuscle Brainstorm! Little. The biceps femoris is a flexor and the quadriceps femoris is an extensor (Fig. 14.15). What happens if (a) you only have 1. The right calf muscle contracts and lifts the heel. The ball of the foot rests on the ground. quadriceps femoris? b) Muscles 2. At the same time, the biceps muscle of the thigh contracts, which flexes the foot in the knee joint. The right leg is raised. attached directly to the bone?3 When the right foot leaves the ground, the weight of the body is now carried by the left foot, which is still on the ground. The quadriceps muscle (extensor muscle) contracts to straighten the leg.4 The calf muscle contracts to lower the heel. When the right heel hits the ground, the weight of the body is shifted to the right foot. The whole sequence is repeated with the left leg. the gastrocnemius muscle, biceps femoris, and quadriceps femoris contract,1 pull the thigh and extend the lower leg to move from side to side due to the contraction and relaxation of the W-shaped muscle segments of the myotome. • These antagonistic muscles work in opposite directions. This allows the fish to flap its tail. When the right myotome contracts, the left myotome relaxes. • Tail curled to the right (Fig. 14.17). • Conversely, when the right myotome contracts, the left one relaxes and the tail turns to the left. • Waves of contraction and relaxation alternate along the myotome. • The action causes the body parts to move from side to side, pushing the water back and forth, propelling the fish forward. • Fins are used to control the movement and direction of the fish. Myotome (a) (b) 14.16. fig. (a) Cross-section and (b) longitudinal section of the fish Movement of the tail propels the fish forward Muscles of the left side Muscles of the right sideTail brake Tail brake right left Tail whip right Tail whip left FIGURE 14.17 Mechanism of fish locomotion 274 14.3.2 BIRD (FLIGHT) The action of the large and strong antagonistic muscles on the bird's thorax assists in flapping the wings. ¢ The wing mechanism of a bird is shown in 14.18. on the picture. Wings move up sternum Air pressure causes Spectoralis Major's wings to move up contraction of the sternum and down a small contraction pulls the wings of the pectoralis minor and pulls down relaxed relaxed wing up 14.18. PICTURE Movement of the bird • When the sternum contracts and relaxes. the wings are pulled down. • When the pectoralis minor contracts and the pectoralis major relaxes, the wings are retracted. Earthworms The alternating contractions and relaxations of the circular and longitudinal muscles produce a peristaltic wave along the body of the earthworm (Fig. 14.19). The longitudinal muscle The circular muscle CHAPTER 14 14.19. FIGURE Longitudinal and circular muscles of the earthworm 14.3.2 2751 The posterior longitudinal muscle contracts 5 The posterior segment, or circular muscle, relaxes; shortened is pulled forward. The earthworm becomes shorter and thicker. the posterior anterior jaw sphincter 3 on the 4th threshold of the anterior segment contracts, and the anterior segment 2 setae on the longitudinal muscles relaxes; Once anchored in the ground by the posterior segment, the earthworm becomes longer while the chaetae are anchored in the ground and become thinner. The anterior segment is the posterior segment, but the chaetae (at the apex) extend anteriorly. Disconnect it from the release ground of the front section. holds her to the ground. 14.20 PHOTO. Earthworm JUMP/LEAP Stretching Movement ext™ exoskeleton The antagonistic sinus muscles, i.e. the flexor and extensor, are attached to the inner surface of the exoskeleton.flex (Fig. 14.21). exoskeleton. Flexors bend the joint and extensors straighten it. stretcher. The grasshopper's muscular and long hind legs are very good at hopping/hopping (Fig. 14.22). Flexors Flexors 1 Exoskeleton Fig. 14.21 Flexors a At rest, the hindlimb flexor and hindlimb extensors contract to pull the leg toward the body. In this position, the back leg is folded into a Z-shape and the spring is ready to hop/bounce. 2 With the subsequent contraction of extensor 3, the back leg kick is extended, the back legs are thrown backwards. Springboard forward and high in the air. FIGURE 14.22 Movement of a Grasshopper 14.3.227614.3 Formative Exercise 1 Why do you think birds are depressed? 3 Explain the mechanism of movement in fish. Bone? 4 Describe how a grasshopper jumps. 2 Explain how the forearm moves. up.14.4 Human musculoskeletal health problems Diseases such as osteoporosis (Figure 14.2), osteomalacia, arthritis and scoliosis can impair the functions of the musculoskeletal system. OSTEOPOROSIS Osteoporosis (Fig. 14.23) is a bone disease characterized by weak bones that are prone to fracture. With age, the rate of calcium loss is greater than the rate of calcium absorption, resulting in a loss in bone mass or density. Factors that contribute to this include a sedentary lifestyle and low intakes of calcium, phosphorus, and vitamin D. Osteoporosis is common in postmenopausal women because their estrogen levels are low. Estrogen is involved in calcium metabolism, helping the body absorb calcium and reducing calcium loss from the bones. Low estrogen levels can decrease bone density due to loss of calcium from the bones (Figure 14.2). (a) Normal bone (b) Bone from a patient with osteoporosis CHAPTER 14 FIGURE 14.23. Bone mass decreases with age. Brittle bones are symptoms of osteoporosis. PHOTOGRAPHY 14.2.and stooped posture. (a) Normal bone (b) The bone of a patient with osteoporosis 277 is thinner, more brittle and more porous. in adults, especially Fig. 14.24 Normal bone and bones of pregnant women with rickets. When it occurs in children, it is called rickets (Fig. 14.24). Rickets causes ARTHRITIS - softening and weakening of the bones in children, leading to bone loss. Osteoarthritis is a common arthritis in the elderly. Osteoarthritis (a)(b) is caused by reduced wear and tear of synovial fluid and cartilage in some joints. The cartilage becomes thinner until osteoarthritis occurs, and the ligament shortens and loses some of its elasticity. Joints such as the knee joint become swollen, painful and less flexible. Arthritis limits daily activities such as walking. Activity Zone Group work SCOLIOZIS The spine of a patient with scoliosis bends to the side and forms an "S" or "C" shape when viewed from behind (Fig. 14.25). Scoliosis can be osteoporosis, caused by a genetic factor or abnormal growth of the spine, osteomalacia, rickets, pubertal development. arthritis and scoliosis. Do scientific research. What treatment is suitable for people with health problems related to the musculoskeletal system? It can help people with health problems related to skeletal muscles. The spine of a patient with normal scoliosis. Spine activity zone. 14.4.1. Building a walker for one person, based on FIGURE 14.25. Scoliosis Patient's Spine 278 Musculoskeletal Health Practices Practices are listed belowpay attention to the musculoskeletal system. CORRECT POSTURE Posture is the posture of the human body when sitting, lying, walking and standing. We should not be lounging, standing or sitting. Grinding puts pressure on the spine, resulting in spinal misalignment. This prevents blood flow, suppression of nerves and vital organs Correct posture when using the computer Wear comfortable clothes and shoes PROPER CLOTHING Wear suitable, comfortable and loose clothing to avoid restricting blood flow and musculoskeletal disorders. A suitable pair of cushioned shoes provides support and prevents back injuries. EXERCISE MKilelerjnanyaiaMl CileanreiaerExercise strengthens joint structure and orthopedics is a specialty medicine that increases the flexibility of muscles and ligaments. Area focused on diagnosis, care Exercise also increases bone strength and treatment of bone and musculoskeletal mineral deposits in adults and preventive systems. Doctors who specialize in treating this osteoporosis in the elderly. The field is called Orthopaedists. Engage in a variety of physical activities BALANCED DIET Eat a balanced diet, CHAPTER 14 foods high in calcium (milk), minerals (phosphates), vitamins C and D. Vitamin D promotes calcium absorption, while vitamin C increases bone mass 14.4.2 279 activity . Zonal Headaches Discuss the musculoskeletal and respiratory effects of shoulder and neck pain: problems and (a) back pain from wearing high-heeled shoes (b) sitting with a wallet in your back pocket (c) carrying a heavy bag (d) poor posture the use of smartphones and computers 14.26. BILD Consequences of incorrect posture when using smartphones. age.System. 4 Explain three techniques that can help. 2 As a doctor, explain how you can maintain musculoskeletal health. Scoliosis patients lead normal daily lives. 14.4.2280Summary POSTURE AND MOVEMENT IN HUMANS AND ANIMALS Types of the human musculoskeletal system Mechanisms of movement Skeletal system and locomotion - Hydrostatic axial skeleton: Mechanisms of movement of the skeleton Skull, spine, "triceps, triceps" of the human ear and forearm ¢ Human leg (biceps femoris) and ¢ Exoskeleton â¢ Endoskeletal structure of the joint: bone, quadriceps femoris) cartilage, skeletal muscle, cecum tendon, ligament, Mechanisms of movement in the skeleton of animals: synovial membrane and â¢ fish â¢ pectoral muscle â¢ pectoralis , synovial fluid â¢ birds â large thoracic and pelvic floor, upper and lower extremities Pectoralis minor health problems • Worms â circular aTypes of joints: fixed joints, longitudinal muscles inactive • Flexor or Grasshop, flexible joints Osteoporosis, rickets, scoliosis, osteomalacia, arthritis Exercises to care for the musculoskeletal system -motor system: physical exercises, sensible diet g, correct posture and appropriate clothing and footwear. Self-Reflection Have you mastered the following important concepts? CHAPTER 14. Types of the human and animal skeleton. Axial and appendicular skeleton. Types of vertebrae in the spine. Types of joints in the human skeletal system. The structure of the joints of the joints. such as earthworms, grasshoppers, birds and fish. Health problems related to the human musculoskeletal system. Methods to keep the musculoskeletal system healthy. 2 In Fig. 1 shows the movement of an earthworm. Direction of Movement T-Segment S-Segment FIGURE 1 Explain the muscle activity in the T and S segments that makes this possiblemove in the indicated direction. 3 Why is it important for the body to keep its shape? 4 Describe the importance of good posture. Why do we always need to practice correct posture in any activity? 5 Explain why muscle contractions require adequate blood flow. 6 Figure 2 shows two types of vertebrae, X Y X and Y in the human spine. FIGURE 2 (a) Name the X and Y vertebrae. (b) Explain the role of the vertebrae in body movement. c) The connection of the thoracic vertebrae with the mechanism of respiration. 7 In fig. 3 shows muscles P and Q, bone Y and tissue X involved in the movement of the forearm. (a) Name muscles P and Q, bone Y, and tissue X. (b) Name two characteristics of tissue X that allow it to work with muscle P depending on Q. Tissue X bone Y (c) If tissue X is torn in an accident, What problems will the victim face? (d) Suggest a suitable food for a person with a Y fracture. In your opinion, explain why this particular food is considered appropriate for this person. (e) Explain how all the parts marked in Figure 3 behave in the state shown. 282 Biceps femoris Essay questions 8 In fig. 4 shows the movement of a person. quadriceps femoris tendon fibula knee FIGURE 4 Use Figure 4 to describe how the muscles, bones, tendons, ligaments, and joints make this movement possible. 9 Describe how the skeletal systems of earthworms and fish are adapted to move in their respective habitats. 10 (a) Explain the characteristics of the muscles involved in human locomotion. (b) (i) Explain steps that can be taken to maintain musculoskeletal health. (ii) Describe factors that may put a person at high risk of developing osteoporosis. (c) Describe how muscles interact with ligaments and tendons when moving the forearm. Enrichment 11 The long bones of mammals are hollow, not compact. Explain the benefits of hollow bones. 12 Birds fly on wings. The movement of the wings allows the birds to soar. However, the ability of birds to flydepends only on its wings, but also on the support system. Explain how the support system helps birds fly. 13 Recent research into bone fracture healing involves the use of materials such as carbon nanotubes that act as scaffolds for bone growth. If you are a scientist looking for a new material to treat damaged bones, what properties should the material have to replace broken bones? Scan the provided QR code for full answers CHAPTER 14 CHAPTER Sexual Reproduction, Development and Growth in Humans and Animals 15 Did you know... htWhuehmaaatnnaarrteeopmthroiecdafuel csatytiuosrtnee?smoof fHow does modern technology help in... How does conception work? happen? menstrual cycle284 • hoHafoptwhpeednho?uems athnefodeetvueslopment 15.1 Human reproductive system 15.4.3 Explain the role of the hormone human chorionic gonadotropin (hCG) in 15.1.1 Describe the anatomy of: early pregnancy. • Male reproductive system • Female reproductive system 15.4.4 Discuss the role of the following structures in fetal development: 15.2 Human gametogenesis: 15.2.1 Justify the need • Placental gametogenesis. • Umbilical cord 15.4.5 Justify the need for separate formation of gametes 15.2.2: • Spermatogenesis of the blood of the fetus and mother • Oogenesis of the circulatory system. 15.2.3 Determine the structure of: Spermatozoon 15.5 Formation of twins Middle part of the head 15.5.1 Describe the processes involved in the formation of twins: Tail Graafian follicles Identical twins - Secondary oocyte - Fraternal twins - Follicular cells 15.5.2 Comparison and comparison of identical twins 15.2.4 Comparison and comparison of dizygotic twins. spermatogenesis and oogenesis. 15.5.3 Correlation of cell division with 15.3 Formation of the menstrual cycle in Siamese twins. 15.3.1 Analysis of level 15.6 changes in health problems associated with the human hormones involvedReproductive System • Menstruation 15.6.1 Give the meaning of impotence. • Follicular development 15.6.2 Inform about the causes of • thickening of the endometrium • ovulatory impotence in humans. • Corpus luteum formation 15.3.2 Correlation of level changes 15.7 Human and animal growth related to hormones: 15.7.1 Explain the importance of growth in pregnant organisms. • Abortion 15.3.3 Definition of the meaning of PMS 15.7.2 Definition of parameters for measuring height in humans and animals. menopausal syndrome and syndrome 15.7.3 Describe the growth of insects with exoskeleton: 15.4 Development of the human fetus - complete metamorphosis 15.4.1 Describe the process of fertilization - incomplete metamorphosis and zygote formation. 15.7.4 Analysis of growth phases 15.4.2 Sequence and explanation of growth curves of the sigmoid in early embryonic and animal development. for implantation: 15.7.5 Analyze the dashed growth curve of animals with exoskeletons. • Two-cell embryo • Morula • Blastocyst 28515.1 Human Reproductive System Male and Female Reproductive Systems The continuity of a species depends on population growth through sexual or asexual reproduction. Sexual reproduction involves the production of male and female gametes by sexually mature individuals. This process culminates in the fertilization of both gametes to create new life. The structure and function of the male and female reproductive systems are shown in Figure 15.1 and Figure 15.2. Fallopian Tubes™ Uterus The uterus is an organ with • a thick, thin, muscular tube. muscle walls. • The inner wall is lined with cilia. • The inner wall of the uterus is lined with endometrial tissue, which secretes cilia and mucus and is • rich in blood vessels. In conjunction with fallopian tube peristalsis, it helps implant the embryo into the endometrium.secondary oocyte or embryo into the uterus. Endometrial tissue, thick and rich in blood vessels, supplies the embryo with nutrients and oxygen. OVARIAN The female reproductive organ that produces the egg (female gamete, plural: ovum) and the female hormones estrogen and progesterone. NECK WATER A duct through which sperm enter and which also serves as a passage. A narrow opening in the uterus for childbirth and menstruation. secretes mucus to help sperm enter the fallopian tubes.286 15.1. FIGURE Female reproductive system 15.1.1. SEED LEAVES secrete a fluid filled with nutrients for sperm. The Deferent Ducts The Prostate Gland Sperm are transported by seminal fluid, which helps in the deferent ducts (vas deferens). sperm movement. TESTICLES TESTICLES A sac-like structure • located in the scrotum and protecting the testicles. • Produces sperm (male gametes) and the male sex hormone testosterone. PENIS-URETRA • The male sexual organ, which is soft tissue and blood for the passage of semen and urine from the vessels. body. • Sperm is ejected into the woman's vagina during intercourse. 15.2. IMAGE. Male reproductive system 1 Name the structures of the male reproductive system. 4 Explain the functions of the fallopian tubes and uterus. 2. Explain the functions of seminal vesicles and scrotum. This process takes place in the gonads, which are the testes in men and the ovaries in women. In gametogenesis, haploid (n) gametes are formed. During fertilization, the sperm nucleus fuses with the egg nucleus in the fallopian tube, forming a diploid zygote (2n). Spermatogenesis Spermatogenesis is the process of sperm production that occurs in the testicles.in Fig. 15.3 shows a longitudinal section of the nuclei. distribution channel. Each vas deferens consists of primordial (vas deferens) reproductive cells. Primordial germ cells undergo cell division to form sperm. The Sertoli cells in the walls of the seminiferous tubules provide nutrients throughout the process. Sperm are transported from the seminiferous tubules to the epididymis and exit through the vas deferens. The spermatogenesis is stimulated by follicle stimulating hormone (FSH) and testosterone. This process is also facilitated by the luteinizing hormone (LH), which stimulates testosterone secretion in the testicles. in fig. Figure 15.4 is a diagram of spermatogenesis. FIGURE 15.3 Longitudinal section of the testicles 288). 2n 2n 2n Each primary spermatocyte undergoes meiosis I to form two secondary spermatogonia 2n (haploid) spermatocytes. n nn Each secondary spermatocyte n undergoes meiosis II to form two nn nn n nn meiosis II haploid sperm. n nn Sperm n n nn Differentiation n nn The spermatids then differentiate into sperm. n nn Sperm n nn nn nn nn CHAPTER 15 FIGURE 15.4 Spermatogenesis15.2.2 nn n n 289 Oogenesis Oogenesis is the process of formation of secondary oocytes or female gametes (Fig. 15.5). This process takes place in the ovaries. In contrast to spermatogenesis, oogenesis begins in the woman's ovaries before birth. BEFORE BIRTH Germ cells 1 Primordial germ cells undergo several mitotic divisions 1 2n germ cells to form an oogonium (diploid). Oogonium Mitosis 2 develops Oogoniumthe primary oocyte is encapsulated by 2n one or more layers of follicular cells to form primary follicles. Follicle growth is stimulated by follicle-stimulating hormone (FSH). The primary oocyte then undergoes meiosis, but this process stops during fetal development in phase I. 2n AFTER BIRTH infant development and 2n primary oocytes infancy from menstruation 3 puberty to 2n primary oocytes primary follicles menopause HAIRY 2n secondary follicles 5 Meiosis I 4 Grafted follicles first polar n secondary oocytes (n) bodies (n) meiosis II n ovulation 6 released sperm secondary ovum n nn 7 8 After ovulation, the remaining polar bodies die from the 8 follicles that form the corpus luteum. n290 Egg Yellow body 15.5. FIGURE Oogenesis 15.2.2 Primary follicle Secondary follicle Primary ovum Corpus luteum Count follicle Secondary ovum 15.6. PAINTING. take at puberty ab.4 After reaching puberty, primary oocytes continue meiosis I, forming secondary oocytes and the first polar body. The secondary oocyte begins meiosis II, which then stops at metaphase II. The first polar body completes meiosis II and forms two second polar bodies.5 The layer of follicular cells surrounds the secondary oocyte and is called the secondary follicle. The secondary follicle then develops into a Graaff follicle, which releases estrogen.6 The mature Graaf follicle approaches the surface of the ovary and releases the secondary oocyte into the fallopian tube. This process is called ovulation.7 The secondary oocyte (immature egg) completes meiosis II as soon as sperm enters it. Meiosis II produces the oocyte(s) and the first polar body(s). Fertilization occurs when the sperm nucleus fuses with the egg nucleus, forming a diploid zygote (2n). The rest of the polar bodies will die and disintegrate.ovary. after 9 years, the corpus luteum continues to grow and fertilization releases estrogen and progesterone. without a corpus luteum and a secondary egg, it degenerates and dies at fertilization, then is removed during menstruation. 15.2.2 291 Structure of spermatozoa and follicles: head, middle part and tail. The head contains a nucleus, and the middle is filled with mitochondria, which generate energy for sperm to swim to the fallopian tubes for fertilization. oocyte head of the middle cell of the secondary tail vesicle 15.8. FIGURE Graaffian follicle 15.7. FIGURE Spermatozoon The secondary oocyte is a large cell surrounded by a jelly-like substance and follicular cells. The secondary ovum and follicular cells form the Graafian follicle. Comparison of spermatogenesis and oogenesis The comparison of spermatogenesis and oogenesis is summarized in 15.1. in the table. 15.1. TABLE Comparison of Spermatogenesis and Oogenesis Similarities in Spermatogenesis Oogenesis... Both are processes of gametogenesis occurring in the reproductive organs. They produce haploid gametes involved in fertilization. Differences. It happens in testicles. It takes place in the ovaries. Spermatogonia (diploid) produce four sperm Oogonia (diploid) produce only one functional (haploid) sperm after meiosis. secondary (haploid) oocyte and three inactive polar bodies after meiosis. Spermatozoa are smaller and consist of a central part, secondary oocytes are large and spherical in the middle and tail. In the shape of. After meiosis I, two secondary spermatocytes are formed. After meiosis I, one secondary egg is formed and one is formed. resulting in a polar body. Meiosis is completed. Meiosis II is completed only when the sperm fertilizes the secondary oocyte. The sperm cell differentiates and becomes a secondary oocyte. Sperm is no different. Since then, sperm production has been continuous. Secondary egg production does not mature until old age.It begins in the female fetus and remains dormant when the baby is born. This process continues when a woman reaches puberty and stops at menopause. Millions of sperm are produced every day. Only one secondary oocyte is released from the ovaries in each menstrual cycle.292 15.2.3 15.2.415.2 Formative Practice 2 Explain three differences between spermatogenesis and oogenesis. 1 What can happen if gametogenesis does not occur? 15.3 The Menstrual Cycle The Role of Hormones in the Menstrual Cycle THE MENSTRUAL CYCLE Biological unilateral lens The menstrual cycle involves the formation of a secondary oocyte and the effects of mild thickening of the endometrial wall during one cycle. In this cycle, the estrogenic endometrium becomes soft, dense and rich in blood vessels. This is the loss of calcium to prepare the endometrium for embryo implantation. If the body is not fertilized, the secondary oocyte dies and the endometrial wall falls off. This will lead to bleeding, known as menstruation. in the bone density, making it porous. The functions of hormones in the menstrual cycle are presented in the table. 15.2. and weak. This condition is called TABLE 15.2 Hormonal Functions in the Menstrual Cycle Osteoporosis. Glandular hormone function KMeirlljeanynaiaMl Cialereneira Pituitary follicle • Stimulates the growth of follicles in the ovaries. ESR and ovarian stimulation • Stimulates the release of estrogen. gynecologists specialize in female reproductive hormones (FSH) and luteinization • Stimulates ovulation. women's health. hormone (LH) • Causes the formation of the corpus luteum15.3.1. • Stimulates the secretion of progesterone. Estrogen • Rebuilds and stimulates thickening of the endometrium. • Stimulates the growth of the hair follicles until they mature. • Stimulates the release of FSH and LH before ovulation. Progesterone • Stimulates the thickening of the endometrium, making it thick, wrinkled and rich in blood vessels.CHAPTER 15 Embryo implantation. • Stops the release of FSH and LH, preventing follicle growth and ovulation. Changes in hormone levels, follicular growth and changes in the thickness of the endometrial wall during one menstrual cycle are shown in the figure. 15.9. 293 HORMONE LEVEL Progesterone LH hormone level Estrogen FSH1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 18 19 20 21 22 23 24 25 26 days 23 24 25 26 days MENSTRUAL CYCLE DENSITY OF ENDOMETRY 15.9. FIGURE Stages of events and changes in hormone levels during one menstrual cycle294 15.3.1. p. 2 3.1. Structure of the plasma membrane 3.3.4. Designing an experiment to study different effects. 1 Justifies the need to move 3.3.5 concentration solutions 3.1. 2 substances through the plasma of animal and plant cells. 3.1.3 membranes. Explain the impact. 3.1.4 Describe the hypotonic, hypertonic and plasma membrane components and their effects on the cell in isotonic solutions based on the fluid mosaic model. on the movement of water molecules: draw and label the components of the "plasma membrane of animal cells" based on the "fluid mosaic model of plant cells". Describe permeability 3.4. Movement of substances across the plasma membrane. Plasma membrane and its daily use 3.2. The concept of substance movement through the plasma membrane 3.4.1. Carry out the experiment 3.2.1. Determine the characteristics 3.4.2. Determine the concentration of substances capable of movement 3.4.3. plant tissue. through the plasma membrane w Correlates the concentration of the following substances: 3.4.4. cell sap in plant tissue with the particle size of plant wilt. • polarity of molecules Explain with examples • application of the concept of ion charge 3.2.2 Carry out experiments to study motionthe movement of substances through the plasma membrane in everyday life. selectively permeable membrane Communicate about reversal using: osmosis in water purification • Visking tube • simple osmometer 3.2.3 Describe with examples the movement of substances through the plasma membrane: • passive transport • active transport 3.2. 4. Compare passive transport and active transport. Explain 3.3.3 with examples. active transport processes in organisms. Define the solution: • hypotonic solution • hypertonic solution • isotonic solution 453.1. ICT plasma membrane structure 3.1. The need for movement of substances Activity: across the plasma membrane To discuss the need for living cells, substances from the external environment are needed. they carry out the movement of matter in living processes. At the same time, metabolic processes in cells through the plasma membrane produce waste products that must be removed from the cells. What substances do cells and cell waste products need? How do these substances move in and out of cells? In order to maintain life processes, cells must allow certain substances to pass in and out of the cells. The movement of substances in and out of the cell is regulated by the plasma membrane. Before you learn how substances move across the plasma membrane, let's look at their structure. Workspace The Structure of the Plasma Membrane Drawing the Model In Chapter 2, you learned that every cell is surrounded by a thin plasma membrane that separates a living cell from its surroundings. within components. A phospholipid bilayer that forms a mosaic pattern that changes frequently. Poles 3.1. the picture shows the plasma membrane. a head that is hydrophilicPhospholipid glycolipid carrier Non-polar protein tail that is a hydrophobic glycoprotein Phospholipid bilayer channel Cholesterol protein) There have been many... Non-polar tail that is a hydrophobic (water-repelling) plasma membrane Head of phospholipid molecules in the outer front layer Models made of of the extracellular fluid, while the inner layer of the phospholipid head contains scientists. But focus on the cytoplasm. The tails of the phospholipid molecules of the two liquid mosaic layers face each other. The model proposed by SJ Singer and GL There are different types of protein molecules that are partially or completely embedded in a membrane. According to the accepted model, protein molecules are widely distributed in the phospholipid bilayer. Protein molecules with channels are now called channel proteins by scientists, while protein molecules that act as carriers are called carrier proteins (Fig. 3.2). Extracellular molecule Pores Extracellular molecule Cytoplasm Cytoplasmic carrier protein Channel protein 3.2. FIGURE Channel and carrier protein models Some proteins and lipids have attached carbohydrate chains, called glycoprotein and glycolipid, respectively (Figure 3.1). membrane by forming hydrogen bonds with water and act as antigens for cell identification. Cholesterol molecules are also located between phospholipid molecules (Fig. 3.1). Cholesterol makes the phospholipid bilayer stronger, more flexible, and less permeable to water-soluble substances such as ions. The phospholipid layer, proteins and cholesterol are not static, but form a dynamic and flexible structure. It contributes to the properties of the plasma membrane and makes it a propertythe plasma membrane is more flexible.3.1.2 3.1.3 47Millennium Careers Plasma Membrane PermeabilityBiochemists What A membrane is said to be permeable to a substance if the cell-specific membrane allows a substance to pass through without obstruction. In contrast, a molecular membrane is impermeable if a substance cannot pass through it. What does selectively permeable membrane mean in pharmaceutical terms? Membrane, as a selectively permeable sector, allows only certain molecules to move freely, while biotechnology prevents or restricts the movement of other substances as well. Forensic investigation. Due to its structure, the plasma membrane has the property of selective permeability. The phospholipid layer and the protein determine the permeability of the membrane to certain substances. In the next unit, we will learn about the properties of substances that can move across the plasma membrane. ICT 3.2 3.1. Formative Tutorial Video: Fluid Mosaic 1. What are the two main components of the plasma membrane? Plasma Model 2 Explain the meaning of the fluid mosaic model. Membrane (as of August 21, 2019) 3. Predict what happens to the plasma membrane in the absence of cholesterol. 4 Explain the role of phospholipids and proteins in maintaining the permeability of the plasma membrane.48 3.1.43.2 The concept of the movement of substances across the plasma membrane Characteristics of substances that can move across the plasma membrane ICT 3.3 There are three general factors that determine whether a molecule can pass through the plasma membrane, there are molecules size, polar molecule and molecular ionic charge movement. and ions through the plasma membrane.water) Examples: • Glycerol • Glucose • Fat soluble vitamins (A, D, E, K) • Non-polar molecules (Examples: • Amino acids • Steroid compounds oxygen, carbon dioxide) • ¢ Ion (Examples: K+, Na+, Ca2+, Mg2+) small and fat-soluble ionic molecules small non-polar molecule H2O O2 CO2 large molecule extracellular carrier protein H2O O2 CO2 channel protein cytoplasm 49 Hypothesis. Only small molecules are able to diffuse through the selectively permeable membrane while large molecule cannot diffuse through the selectively permeable membrane. Manipulation possible: Molecular size. test tube, Bunsen burner, pipette and measuring cylinder. Procedure 1 Soak the whipping tube in water for 5 minutes to soften it. Make a knot and tie one end of the Visking tube with string to prevent leaks. 2 Fill the whipping tube with 10 ml of glucose solution and 10 ml of starch slurry. Tie one end of the tube tightly with a whisk thread. The color of the solution is noted. 3 Rinse the outside of the visking tube with 400 ml distilled visking water. distilled water 10 ml of glucose 4 Add 400 ml of distilled water to the beaker. solution + 10 ml of starch. 5 Place the whipping tube in the beaker and let it weigh for 30 minutes. 6 After 30 minutes, remove and translateVisking tube for dry beaker. 7 a) Perform the iodine test on the solutions in the Visking test tubes and beaker. Place 2 ml of each solution in separate test tubes and add 1 ml of iodine solution. Note the resulting color. (b) Perform Benedict's test with Visking tube and beaker solutions. Place 2 ml of each solution in separate test tubes and add 1 ml of Benedict's solution. Heat the solutions in a water bath for 5 minutes and note any color changes.50 3.2.2 Results Contents Iodine test Benedict's test Visking test tube Beaker 10 ml glucose solution + CHAPTER 3 10 ml starch suspension 400 ml distilled water Discussion 1 What is the molecule in the beaker (a) in the visking tube (b)? 2 What conclusions can be drawn from (a) the particle size of starch (b) the particle size of glucose compared to the pore size of a Visking tube? What are the Similarities Between Visking Tube and Plasma Membrane? Conclusions Is the hypothesis accepted? Develop a suitable application. 1.2 3.2 Active initiative Investigating the movement of substances in a Visking tube experiment using a simple osmometer Problem Solving How do water molecules pass through selectively permeable membranes? Hypothesis Water molecules diffuse from an area of high water potential to an area of low water potential. Manipulated variables: Time response: Increase in the level of sucrose solution in the capillary tube Fixed: Concentration of sucrose solution Materials 30% sucrose solution, Visking tube (12 cm), thread and distilled water Apparatus Retort stand with clamp, 25 cm capillary, syringe, ruler, 50 ml beaker, pen, scissors and stem Procedure 1 Cut the Visking tube (12 cm). 2. Soak the Visking tube in water for 5 minutes to soften it. 3 Tie one end of the Visking tube tightly with thread to form a pouch. 4 Using a syringe, fill the Visking tube with 30% sucrose. 3.2.2 515 Tie the other end tightlytubes to the capillary. initial capillary mirror 6 Rinse the outside of the Visking tube with distilled water. Sucrose solution 7 Attach the capillary vertically to the distilled water stand in the retort. Visking tubes 30% sucrose 8. Immerse the Visking tubes in a beaker of distilled water solution. 8 10 12 9 At the beginning of the experiment, mark the filling level of the sucrose solution in the capillary with a marker. 10 Measure and record the level of the sucrose solution in the capillary tube every 2 minutes from the previous level for 12 minutes. 11 Draw a graph of sucrose solution level (mm) versus time (minutes). Results Time (minutes) 0246 Sucrose solution level (mm) Discussion 1 Using a graph, explain the relationship between sucrose solution level and time . 2 What caused the change in the level of the sucrose solution? 3 What conclusions can be drawn about the size of the sucrose and water molecules and the pore size of the Visking tube? 4 Predict the results by repeating the experiment using a Visking tube filled with distilled water and a beaker filled with a 30% sucrose solution. Conclusion Is the hypothesis accepted? Suggest an appropriate conclusion. Our biological world The movement of substances across the plasma membrane occurs by passive and active transport. They know that egg membrane can be used for passive transport to replace vizking. An analogy for passive transport is like riding a bicycle. Hose? Can you process, no energy consumption required. Examples of passive transport are simple diffusion, osmosis, and facilitated diffusion. Motile molecules are said to move along a concentration gradient until dynamic equilibrium is reachedcan occur with or without the presence of solutes: cell membrane fatty acids. The fat-soluble oxygen molecules glycerol (fatty acids and glycerol), oxygen and carbon dioxide carbon dioxide diffuse through the phospholipid bilayer by simple diffusion (Fig. 3.4). 3.4. FIGURE Simple diffusion across a phospholipid bilayer Osmosis is a passive transport process similar to diffusion but involving only water molecules. Osmosis refers to the net random movement of water molecules from an area of high water potential (low solute concentration) to low water potential (high solute concentration) through a selectively permeable membrane. A selectively permeable membrane is permeable to water but impermeable to some solutes, such as sucrose molecules (Fig. 3.5). The same situation occurs in cells through the phospholipid bilayer (Fig. 3.6). Facilitated Diffusion of Bilayer Water Molecules Fat-insoluble molecules such as ions, large molecules such as amino acids and glucose cannot pass through the phospholipid bilayer. These substances move across the membrane with the help of transport proteins (carriers or channel proteins). This process is known as facilitated diffusion. Facilitated diffusion does not require energy because transport proteins transport molecules down a concentration gradient. This process continues until dynamic equilibrium is reached, when the concentration of molecules is equal on both sides of the membrane. 3.2.3. 53 CHANNEL PROTEINS form channels or channels for glucose ions, allowing the diffusion of solutes and small ions across the plasma membrane. channels are indicatedonly certain ions pass through. CARRIER PROTEINS have specific locations and can only bind to a specific molecule. For example, glucose molecules can only bind to a specific glucose site. FIGURE 3.7 Facilitated diffusion through the channel and carrier protein. Carrier proteins The process of moving glucose molecules through the plasma membrane is based on facilitated diffusion (Fig. 3.8). Extracellular Extracellular glucose Glucose binds glucose at a certain concentration at a certain location where there are higher carrier proteins than in the cytoplasm of carrier proteins. Cytoplasmic Proteins Carriers Carrier proteins come back to change shape, and the original shape takes on glucose and is ready to transport molecules by carrier molecules. Proteins and enter the cell. FIGURE 3.8 Facilitated Diffusion with Carrier Proteins Active Transport The movement of substances across the plasma membrane can occur by active transport. The characteristics of active transport are as follows: The movement of a molecule or ionic species across the plasma membrane occurs against the concentration gradient. • Requires energy from ATP (adenosine triphosphate) molecules produced during cellular respiration. • Requires a specific carrier protein with specific binding sites to specific molecules or ions. Carrier proteins also have receptors for binding to ATP molecules. Carrier proteins change shape when a phosphate group attaches to them. As a result, molecules or ions move across the membrane (Fig. 3.9).54 3.2.3 Active transport leads to the accumulation or excretion of molecules or ions within the cell. Carrier proteins involved in active transport are called pumps. For example, in animal cells, the carrier proteins that transport sodium ions into the extracellular space and potassium ions into the cell are called the sodium-potassium pump. The mechanism of the sodium-potassium pump is shown in Figure 3.9.1Fluid: 2 Na+ 3 CHAPTER 3 Na+ High Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Na+ Cytoplasm: Na+ P Na+ PLLLow Na+ Na+ carrier, then the sodium ion is transported out of the cell with the help of three sodium ions, which bind to molecules of the ATP carrier protein (adenosine triphosphate). carrier protein. they break down into ADP (adenosine diphosphate) and P (phosphate). The phosphate group is bound to the carrier protein.4 K+ 5 K+ 6 Extracellular fluid: K+ K+ Low concentration K+ K+ K+ K+ K+ Cytoplasm: K+ K+ P K+ K+ K+ K+ High concentration K+ K+ K+ K+ K+ Two potassium ions from outside the cell Loss of the phosphate group restores potassium ion and binds to the carrier protein. Phosphate is the original form of the carrier protein. carrier protein to a group of cells leaves the carrier protein. Rice. 3.9. The sodium-potassium pump There is another type of pump known as +extracellular fluid: the proton pump. For example, ATP + low pH proton pumps are found in the epithelial cells lining the stomach cavity at high concentrations. The proton pump causes the H+ carrier protein to become acidic due to hydrogen ions in the stomach contents. The energy of ATP H+ ensures the transport of hydrogen ions through the cytoplasm: carrier proteins (proton pump) to the extracellular fluid with high pH + H+ H+. This causes the accumulation of hydrogen ions and the formation of acid in the stomach cavity from hydrogen ions +H+. The mechanism of the proton pump is described in fig. 3.10+. FIGURE 3.10 Proton pump 3.2.3 55 energy does not move and after the desired substance through the concentration gradient PASSIVE membrane TRANSPORT requires energy until a dynamic equilibrium is reached TRANSPORT occurs through a gradient membrane selectively permeable to concentration Accumulation and utilization of molecules or ions3.11 Similarities and differences between passive and active transport 3.2 Formative practice 1 Give some examples of substances that can cross the phospholipid bilayer. 2 Describe how sodium ions are transported out of the cell. 3 A scientist conducts an experiment by soaking the roots of a plant in a solution containing mineral salts with varying concentrations of oxygen. Explain why the concentration of mineral salts in the roots increased with an increase in the concentration of oxygen in the solution by 10%.56 3.2.43.3 Movement of substances through the plasma membrane of living organisms CHAPTER 3 Active and passive transport in living organisms Living organisms? Passive transport in the body occurs during: Active transport in the body occurs during: • alveolar gas exchange and • absorption of glucose and amino acids in the capillaries through simple diffusion villi (Fig. 3.12) • glucose reabsorption in the kidneys • water reabsorption occurs by osmosis through the tubules in kidneys renal tubules in the kidneys • transport of sucrose from the leaves to the phloem • absorption of water by the hair cells of the plant root by tissue osmosis (Fig. 3.13) • absorption of mineral ions by plants hair root absorption of the fructose molecule in the villi of the cell (Fig. 3.13) alveolar blood facilitated by air diffusion from pulmonary veins water layer blood from pulmonary artery oxygenated blood mineral ions absorbed into water diffuses by osmosis capillary root cells active from soil water to transport root hairs cells oxygen O2 CO2 deoxygenated molecules blood diffuses from alveolus. the molecules diffuse from the salt into the blood vessels to the alveoli along a concentration gradient. FIGURE 3.12. Gas exchange in the alveoli is simpleRoots Root hairs Soil Grains Roots FIGURE 3.13 Water uptake by osmosis and uptake of mineral ions by active transport 3.3.1 3.3.2 57 Isotonic, hypotonic and hypertonic solutions In general, there are three types of solutions: isotonic, hypotonic and hypertonic. As you already know, water diffusion occurs by osmosis from a region of high water potential to a region of low water potential across the plasma membrane. An explanation of each solution is provided in Table 3.1. Term TABLE 3.1 Isotonic, hypotonic and hypertonic solutions Explanation Definition Isotonic solution Solutions A and B of a selectively permeable membrane Solutions A and B have the same isotonic concentration with respect to each solution. selectively permeable membrane etc. No net water movement. A B water A B mwaotleercmuloelescule selectively permeable membrane A B water molecule Hypotonic solution A has a low selectively permeable membrane Solution A is the hypotonic concentration of the solution dissolved in solution B. Water and flood diffuse from the potential of solution A. AA BB into B by osmosis. solubles AB Hypertonic solution A has a high AB Solution A is a hypertonic solution with a solute concentration of B. Water diffuses, and low AB water from solution B to A by potential. selectively permeable osmosis membrane. A Soluble region of activity 3.3.3 Conduct an experiment to observe the effect of osmosis on the egg plasma membrane58. Influence of hypotonic, hypertonic and lentisotonic biological solutions on animal and plant cells. dissolves like glucose and minerals in red blood cells. salt. The fluid inside a cell is called intracellular fluid. Each cell is surrounded by extracellular fluid. CHAPTER 3 Therefore, the process of osmosis and movement of water through the plasma membrane always takes place in the cell, depending on the water potential of the extracellular fluid and intracellular fluid.• When red blood cells are placed in a hypotonic solution, water diffuses into the cells by osmosis, causing the cells to swell and eventually rupture. This is because the plasma membrane is too thin to withstand the osmotic pressure that builds up in the cells. • The breakdown of red blood cells is called hemolysis. EFFECT OF HYPOTONIC HYPERTONIC SOLUTION • When red blood cells are placed in an isotonic and hypertonic solution, water will flow out of the hypertonic cells by osmosis. SOLUTIONS • This will reduce the size of the cells. ANIMAL CELLS. • ISOTONIC EFFECTS Red blood cells are said to be produced. • Water diffuses into and out of cell 59 by osmosis at the same rate. • There is no clear flow of water across the plasma membrane Cells retain their normal shape 3.3.4 3.3.5. EFFECT OF A HYPOTONIC SOLUTION When plant cells are placed in a hypotonic solution, water diffuses into the vacuoles by osmosis. This will cause the vacuole to expand and push the cytoplasm and plasma membrane against the cell wall. In this state, the cells are under stress. Plant cells do not burst because the cell wall is hard and strong. Turgor is important. plant cells as it provides support and maintains the shape of the cell. Swelling of the cells causes the guard cells to swell, leaving the stomata open for photosynthesis. EFFECT OF HYPERTONIC SOLUTION HYPOTONIC EFFECT When plant cells are placed in hypertonic isotonic solution I, water will diffuse out of the vacuole by osmosis. HYPERTONIC SOLUTIONS - The vacuoles and cytoplasm of PLANT CELLS contract, causing separation of the plasma membrane from the cell wall. This process is called plasmolysis. Plasmolysis causes curvature and wilting of leaves and stems. Plasmolized plant cells can regain their rigidity if they are immediately placed in a hypotonic solution. They say the cages are open.EFFECT OF ISOTONIC SOLUTION • When the plant cell sap and the extracellular solution are isotonic, the water potential is the same. • Diffusion movement of water into and out of cells is equal. • Cells become flaccid.60 3.3.4 3.3.51.2 3.3 Activity Investigating the effects of hypotonic, hypertonic and isotonic solutions on animal cells Problem What effect do hypotonic, hypertonic and isotonic solutions have on animal cells? Hypothesis Blood CHAPTER 3 ¢ A hypotonic solution will explode the cell. In danger! • A hypertonic solution causes the cell to shrink. Chicken red blood cells • Isotonic solution keeps cells normal. stored in sodium chloride solution to prevent blood clots Variables Filter paper Manipulated: Ambient solution concentration Response: Chicken blood cell status Determined: Ambient temperature and cell types Materials Fresh chicken blood, 0.15 M and 0.50 M sodium chloride solutions , filter paper and distilled water apparatus Light microscope, glass slide, dropper, mounting needle and cover glass Procedure 1 Prepare four slides and label them A, B, C and D. 2 Place a drop of fresh chicken blood on slide A and place the slide on its cover. 3 Observe the shape of the red blood cells under a light microscope. 4 Place a drop of distilled water on slide B and cover with a coverslip. 5 Add a drop of blood to the edge of one side of the coverslip. At the same time, place the filter paper on the opposite side of the coverslip so that the blood is distributed under the coverslip. 6 Examine the slide under a light microscope and record the shape of the red blood cells in the table below. 7. Repeat steps 4 to 6. Replace the distilled water with 0.15 M sodium chloride solution (Slide C) and 0.50 M sodium chloride solution (Slide D). Cells in distilled water) C (erythrocytes in 0.15 M sodium chloride solution) D (red cellsin 0.50 M sodium chloride solution) Discussion 1 Discuss and explain the results obtained for each slide. 2 Which solution is hypotonic, hypertonic and isotonic for red blood cells? 3 What happened to the red blood cells in pictures B and D. Summary Was the hypothesis accepted? Recommend a suitable application. 3.3.4 611.2 3.4 Activity seitivitc Investigation of the effects of hypotonic, hypertonic and isotonic solutions on plant cells Content of the problem What is the effect of solutions of different concentrations on plant cells? ¢ Hypertonic solution causes plasmolysis of plant cells. ¢ Isotonic solution causes plant cells to relax. Variables Sucrose filter paper Manipulated: Ambient solution concentration Solution Reaction: Plant cell status Corrected: Plant cell types Materials 0.50 M and 1.0 M sucrose solutions, distilled water, filter paper and bulbs Apparatus Light microscope, slides, coverslips, small knife, mounting needle dropper and forceps Procedure 1 Prepare three slides and label them A, B and C. 2 Remove the epidermal layer (peel) from the inner surface of the onion skin leaf and place it in a drop of distilled water on slide A Use a slide coverslip. to cover the glass. 3 Look at the epidermal cells of onion leaves under a microscope. Draw and label your observation. 4 Remove another layer of epidermis (skin) from the onion skin leaf and place it on slide B. Cover with a cover slip. Add a drop of 0.50 M sucrose solution to the edge of one side of the coverslip. Spread the solution under the coverslip, placing the filter paper on the opposite side of the coverslip. Examine the epidermal cell under a microscope. Draw and label your observation. 5 Repeat step 4, replacing the 0.50 M sucrose solution with a 1.0 M sucrose solution (slide C). 6 Pour the excess distilled water through the onion leaf onto slide C. Observe the cells underneath.microscope. Draw and describe your observation. Results Observation of the glass slide Signed cell shape drawing A (distilled water) B (0.5 M sucrose solution) C (1.0 M sucrose solution) Slide C after decantation of excess distilled water 62 3.3.4 Discussion CHAPTER 3 1 Discuss and explain your results for each slide. Which solution is hypotonic, hypertonic and isotonic for plant cells? What happened to the plant cells in image C? Summary Was the hypothesis accepted? Develop the right application. Ac1ti.v2ity 3.5 Study and determination of the concentration of the experimental extracellular solution isotonic to the juice of plant cells Task Task What is the concentration of the extracellular solution isotonic to the juice of potato cells? Hypothesis. The concentration of extracellular isotonic solution in relation to juice from potato cells does not change the mass of juice from potato cells. Controlled variables: Concentration of sucrose solution. Relevant values: Percentage difference in weight of potato chips. Fixed: soaking time, ambient temperature and potato type. M M sucrose solutions and filter paper Instrument Test tube, corkscrew, knife, tongs, ruler, 50 ml beaker, graduated cylinder, test tube rack and electronic balance and G. 2 Fill each beaker with the following solutions: Attention! Beaker A: distilled water Beaker E: 0.4 M sucrose solution Do not hold potatoes Beaker B: 0.1 M sucrose solution Beaker F: 0.5 M sucrose solution Keep your hands free when slicing. Beaker C: 0.2 M sucrose solution should be used as a base. Beaker G: 0.6 M sucrose solution. Beaker D: 0.3 M sucrose solution 3 Insert a medium-sized corkscrew into the potatoes. 4 Then the strip of potatoes is removed from the corkscrew. 5 Then the potato strip is cut to a length of 50 mm. 6 steps 3 to 5 are repeated to get 6 morepotato noodles of the same length. 7. Coat the potato noodles with filter paper and weigh each one to get the initial weight. 8 Pour the solutions from beakers A to G into tubes A to G. Each potato strip is completely immersed in each tube. 3.4.1 639 After soaking for 30 minutes, remove each potato strip from its respective test tube and dry with filter paper. Weigh each strip to get the final weight. 10 results are recorded. The percentage difference in weight is plotted against the concentration of the sucrose solution. Results Beaker Weight of potato strips (g) Percentage difference from initial weight Final weight (g) Test difference Weight of distilled water (%) Test tube 0.1 M sucrose solution A B Discussion 1 What is the texture and condition of each potato strip after soaking in different concentrations of solutions sucrose? 2 How to determine from the graph the concentration of a sucrose solution that is isotonic to the potato juice cells? 3 Based on the experiment, discuss the process of osmosis in different concentrations of sucrose solutions. Conclusion Is the hypothesis accepted? Suggest a suitable conclusion. 3.3. Formative exercise 1. Explain what happens to the following cells when they are immersed in a solution with a higher concentration of solutes than in the intracellular fluid: (a) erythrocytes (b) plant cells 2. Explain the effect of a hypotonic solution on erythrocytes . 3 Explain the effect of an isotonic solution on plant cells. 4 Based on the concept of osmosis, explain the following situations: a) Why do pawns splash water on fruit and vegetables? (b) Explain what happens when strawberries are sprinkled with sugar.64 3.4.13.4 Plasma Membrane Movement and Its Everyday Use CHAPTER 3 You must have eaten pickles, salted fish and fruit before. How are the terms osmosis and diffusion applied to food preservation? You can also use the conceptsubstances through the plasma membrane by conduction Activity 3.6.1.2 3.6. Activist initiative Application of the concept of substance movement across the plasma membrane project Materials Eggs, bananas, cabbage, various fruits, jelly fish, sugar, salt, vinegar and boiled water Apparatus Malaysian innovation Knife, bottle and oven Procedure Research team 1 Do the activities as a group. Malaysia managed to develop Sil-RH 2. Apply the concept of the movement of substances through the plasma membrane in food production. Membrane distillation. This membrane is made by 3 Use local ingredients and sell products to schools. from rice husks and can be used to 4 Among the dishes you can prepare is a colorful desalination process. canned eggs, smoked bananas of various flavors, salted fish, cucumbers and cauliflower. Fresh plants Plant wilting phenomenon Excessive use of fertilizers can cause plants to wilt. The dissolved fertilizers will make the soil water hypertonic to the root sap cell. The water will then diffuse from the root cell sap into the soil by osmosis and the cells will undergo plasmolysis. Plant cells regenerate after watering. However, if the plasmolysis time is prolonged, wilted plants eventually die. Dried herbs3.4.2 65 The concept of movement of substances across the plasma membrane has many applications in our daily life, such as: rehydration drinks such as saline for oral use, commonly used in rehydration salts, medical aids, isotonic solutions to replace water and blood plasma loss . It contains 0.85-0.90 g of the electrolyte in the human body sodium chloride per 100 ml in case of diarrhea. Isotonic drinks help athletes replace water-insoluble preparations for water loss and transport hydrophobic substances in electrolytes, such as potassium and sodium, through sweat through water-soluble preparations. transported in the hydrophilic region. Liposomes are vesicles that contain watersurrounded by a bilayer phospholipid membrane. Liposomes are used to protect orally administered drugs or drugs from being destroyed by gastric juices. This allows the drug to reach the target cells. Reverse osmosis is a technology commonly used to extract fresh water from sea water using a membrane used in the desalination process. In a reverse osmosis system, pressure is applied to push salt water, fresh water, sea water through a semi-permeable membrane. enter exit outside The membrane allows water molecules to pass through, but not foreign particles, salts and foreign particles, water molecules and microorganisms. As a result, only pure freshwater microorganisms are isolated. 3.4. field of activity. Formative Practice Look at the reverse osmosis process in step 1. Explain why green peppers are preserved with vinegar and sugar. water purification. 2 Pickled pineapples are prepared by soaking pineapple chunks in a thick ICT 3.4 sugar solution. Name two pros and cons Video: liposomal application of this method compared to storing fresh pineapples. (As of August 21, 2019) 3 Ariana had diarrhea after eating stale food. Suggest something66 to help her get well. 4 A liposome is a vesicle containing an aqueous solution surrounded by a bilayer phospholipid membrane. Tell us about the use of liposomes in everyday life. 3.4.3. 3.4.4. Summary MOVEMENT OF SUBSTANCES THROUGH PLASMA MEMBRANES Plasma structure The concept of membrane movement Movement of substances through the plasma membrane through substances through the plasma membrane in the plasma membrane Mosaic of fluid in the plasma membrane and its application in the plasma membrane Everyday life of organisms • Plasma membrane • passive • passive and active • phenomenon consists of transport transport in living plants that desiccate carrier proteins, â simple organisms transport proteins, diffusion • application of phospholipids • osmosis • isotonic movement, hypotonic movement. ,Excipients and hypertonic glycoproteins, diffusion solutions through glycolipids and plasma membrane in cholesterol • Active substances • Effects of isotonic solutions, hypotonic and hypertonic solutions in daily transport • Reverse osmosis on animal cells and plant cell purification process Have you learned an important concept after self-reflection ? • The need to move substances across the plasma membrane • Components of the cell membrane and its functions based on the fluid mosaic model • Permeability of the cell membrane • Characterization of substances that can move through the plasma membrane • Passive and active transport • Hypotonic, hypertonic and isotonic solutions • The effect of solutions of various concentrations on Plant and Animal Cells—Application of the concept of the movement of substances in the plasma membrane in everyday life 67 Workbook 3 1 Define passive transport. 2 Membrane properties determine whether a molecule can move across the membrane. Explain why the plasma membrane is impermeable to many types of molecules. 3 Explain why canned food is a thick sugar solution. 4 (a) Explain the role of the contractile vacuole in the control of water balance in Amoeba sp. (b) Predict what will happen when Amoeba sp. will move to the sea. Explain your answer. Rice. 5(a) 1 shows one component cell within a cell. Extracellular (i) Name the component of the cell in Figure 1. XX: (ii) Labels X and Y. (b) In the experiment, the palisade mesophyll is soaked for some time in filtered water. Explain what Y: will happen to the cell. 6 In fig. 2 shows how substances move across the intracellular plasma membrane. Explain why the calcium ion in Fig. 2 in fig. 1 is transported to the extracellular space. Extracellular Intracellular site ATP ADP Ca2+ ATP P FIGURE 2 7 Studies have been conducted on the effect of various concentrations of salt solutions on human erythrocytesA drop of blood was dripped into three test tubes A, B and C with different contents of the solution. Tube A contained 4.5% sodium chloride, tube B contained filtered water, and tube C contained 0.85% sodium chloride. Set all three test tubes aside for 30 minutes. (a) Explain the solution observed for each tube at 30 minutes. (b) Describe your observations in test tubes A and B. (c) Draw the shape of the erythrocyte in each tube as viewed under the microscope. d) Prepare a suitable concentrated solution for the preservation of red blood cells. Justify your answer.68 Essay Questions 8. State the similarities and differences between simple diffusion and osmosis. 9(a) Some housewives soak vegetables in salt solution before cooking to get rid of pesticides and worms. (i) Explain why vegetables soaked in salt solution for too long wilt. (ii) Suggest a way to revive the vegetable. b) Explain in detail how amino acid molecules move across the plasma membrane. c) Cosmetic cream containing liposomes is considered more effective in skin care. Please rate this statement. Exercise 10 You work in a company that produces drinks for different groups of athletes. The recommended concentration of carbohydrates in drinks is as

follows: for exercisers: 1-3%; middle distance runner: 6-8%; and football player: 10-12%. Justify the concentration of the beverages produced. 11 The speed of movement of material P and material S across the plasma membrane is shown in Figures 3 and 4. (a) Give an example of material P and explain how material P can move across the plasma membrane. (b) Compare the motions of material P and material S in the plasma membrane. Movement speed P (mg s-1) Movement speed S (mg s-1) 0.4 Movement speed S (units s-1)10"1 0.3 Movement speed S (units s-1) P 0.210" 2 P SS10"3 0.110"4 5 10 10"4 5 10 0P (Unit) ConcenCotrnacetniotrantioon fofmmaatetreiarl iSa(lunSit) (Unit) FIGURE 3 FIGURE 4 Scan the QR code provided on your mobile phone for complete answers? elements and molecules to be â¢ acWanhdrhdbaanotituhsaacyrrieldmeerittpcahhtoeaeercstepai,ldrenposmcrp?oeeetniernttiinseassf,cooleuifplnlw?iddasit¢nerused for biological control of fresh water â¢ acWnahdrbanotuhiscyldtehricaetaiemcsi,pdposrrotinatenaicncese,ollfi?pids704.144.1 Describe the properties of lipid molecules. 1.2 Water Correlating properties 4.4.1 List the elements that make up lipids. water with its 4.4.2 Explain the meaning of the main species in class. 4.4.3 lipids. 4.4.4 Describe the formation of carbohydrates 4.2 and the breakdown of 4.4.5 and triglycerides. 4.2.1 List the designation elements and explain carbohydrates. Word formation equation 4.2.2 Explain the types of breakdown of carbohydrates: triglycerides. Justify the importance • of monosaccharides. lipids in the cell and • disaccharides. multicellular organisms. • polysaccharides. 4.5 Nucleic acids 4.2.3 Conceptualization 4.5.1 List the elements that make up nucleic acids. decomposition: • disaccharides. 4.5.2 Explain the structure • of polysaccharides. nucleotides: 4.2.4 Write and explain the verbal equation for the formation of nitrogenous bases and the formation of ribose or the breakdown of a disaccharide. sugar deoxyribose 4.2.5 Justify the importance of phosphate carbohydrate in the cell. 4.5.3 Describe the structure of proteins 4.3 Nucleic acids: • deoxyribonucleic acid 4.3.1 List the elements of 4.3.2 proteins. acid (DNA) Understand • formation of ribonucleic acid 4.3.3 and cleavage of dipeptides (RNA) 4.3.4 and 4.5.4 Explain the importance of polypeptides. Write and explain nucleic acids in cells: a verbal equation for â¢innate creation and division of information. dipeptides. • production Explain the importance of proteins in the cell. protein. 4.5.5. Describe the formation of chromosomes from DNA and proteins. 714.1 Water In form 2 you learned briefly about water and organic compounds. Examples of organic compounds are carbohydrates, proteins, lipids and nucleic acids. What is the function of organic compounds and water in the cells of the body? Properties of water and its role in the cell H O H WATER POLARITY O H • Water is an inorganic compound consisting of the elements hydrogen (H) and oxygen (O). hydrogen bonds • Water molecules are polar because they are separated. • This polarity creates hydrogen bonds and allows water to act as a universal solvent (Figure 4.1). • The versatile solvent properties of water enable the transport of solutes such as glucose and electrolytes across plasma membranes in cells for biochemical reactions. THE POWER OF COMMUNICATION AND THE STRENGTH OF CONNECTION WATER cohesive™ xylem vessel Water molecules are bonded together by the force of adhesion. adhesive force. At the same time, water molecules also stick to other surfaces due to the adhesive force. 4.2. FIGURE Cohesive force and cohesive force in a xylem tube. Both forces cause capillary action, which allows water to enter and move through narrow spaces, such as the xylem tube. Brainstorm! PHOTO 4.1. SPECIFIC HEAT OF WATER A polar bear in an environment of ice-covered seawater • Water has a high specific heat for animals living in frozen seawater, 4.2 kJ kg-1 °C-1. • This means that raising the temperature of one kilogram of water by 1°C requires 4.2 kJ of thermal energy. • Water absorbs a lot of heat energy with little increase in temperature.Characterization is very important for maintaining the body temperature of organisms. 4.1. ICT building practice 4.1. 1. What are chemical bonds 3. Explain what it means to break a glue when water changes the strength and cohesion. Quiz: See if you understand, from liquid to vapor? water 4 Explain how sweating helps 2 Why polar water lowers body temperature. molecule?72 4.1.1 4.1.24.2 Ohydrts CHAPTER 4 PHOTOGRAPHS Organic substances are chemical compounds that contain carbon4.2 Foods rich in elements. Large and complex compounds make up macromolecules. Most carbohydrate macromolecules are polymers that contain small molecules known as monomers (building blocks). Carbohydrates, proteins and nucleic acids are polymer molecules of organic compounds. Carbohydrates are important as a source of energy and the basic structure of some organisms. Carbohydrates are organic compounds consisting of the elements carbon (C), hydrogen (H) and oxygen (O) in the ratio 1:2:1 and with the chemical formula (CH2O)n. Types of Carbohydrates There are three main types of carbohydrates, which are: • monosaccharides (simple sugars) • disaccharides • polysaccharides (complex sugars) Monosaccharides Monosaccharides are carbohydrate monomers, which are the simplest units of carbohydrates. Monosaccharides can combine to form polymers in a condensation reaction. Most monosaccharides have a sweet taste, can form crystals and dissolve in water. Examples of monosaccharides: • Glucose is a sugar found in plants such as rice and wheat, and in fruits such as grapes. Glucose is the most common monosaccharide and most polysaccharides are made from this sugar. Fructose is a sugar found in honey and sweet fruits. • Galactose is found in milk. A monosaccharide has reducing power, which is the ability to transfer hydrogen (or an electron) to other compounds. This is called the reduction process. When a monosaccharide is heated in Benedict's solution,reduces blue copper (II) sulfate to a brick-red precipitate of copper (I) oxide, insoluble in water. All monosaccharides lead to this reaction and are known as reducing sugars. 4.2.1 4.2.2 73Activity Zone Disaccharides Plan your experience Disaccharide molecules are formed when two simple sugar molecules (monosaccharides) condense together to form a reducing disaccharide unit. This process involves the removal of water sugar and a non-molecular reducing sugar (sucrose). Condensation of glucose + glucose Maltose + water Condensation of glucose + fructose Sucrose + water Condensation of glucose + galactose Lactose + water Disaccharides can also be split into monosaccharide units by hydrolysis and addition of a water molecule. Hydrolysis of maltose + water Glucose + hydrolysis of glucose Glucose + fructose Hydrolysis of sucrose + water Glucose + galactose Lactose + water Examples of disaccharides are sucrose, maltose and lactose (Fig. 4.3). Lactose and maltose are reducing sugars, while sucrose is a non-reducing sugar. Maltose is found in the lactose of milk grains, and its sources are reduced solutions of copper (II) sulfate. If 4.2.2 4.2.3 4.2.4 sucrose is hydrolyzed (broken down) to monosaccharide units (glucose and fructose) at an earlier time, the Benedict test shows a positive result for monosaccharide monomers. Understanding Like disaccharides, polysaccharides are formed by condensation and contain hundreds of carbohydrate monosaccharides that form long molecular chains. Due to their large molecular size, polysaccharides do not dissolve in water. Polysaccharides do not have a sweet taste and do not crystallize. Polysaccharides can also be broken down.Hydrolysis with dilute acids, boiling and the action of enzymes. Polysaccharides play various roles in organisms. Importance of carbohydrates in cells • As a source of energy, ie. B. Glucose • As a food reserve, ie. B. glycogen in animal cells and starch in plant cells • As a support structure, eg. B. Cellulose in Plant Cell Walls The main component of plant cell walls is starch. Storage of polysaccharides in plants. Starch is also a plant cell found in chloroplasts. Wall source: cereals, potatoes and legumes. Glycogen is the main depot. PHOTO 4.4 Examples of polysaccharides Polysaccharides are found in muscle and liver cells of animals. 4.2 Formative practice 4 Explain why sucrose is a non-reducing sugar in our world of biology. 1 List the elements that make up carbohydrates. Chitin, a type of polysaccharide, is used. 2 Name the main types of carbohydrates. like surgical thread. The advantage is that chitin breaks down non-reducing sugars. after the sutured wound has healed. 4.2.3 4.2.5 754.3 Protein Protein is a complex compound of the elements carbon, hydrogen, oxygen and nitrogen. Most proteins also contain sulfur and phosphorus. High protein foods include fish, meat, milk, beans, and eggs. All proteins are made up of one or more polymers called polypeptides. Each polypeptide is made up of monomers or small units called amino acids. A polypeptide may consist of fifty to one thousand amino acid molecules. Amino acids combine in the process of condensation. Dipeptides are composed of two amino acid molecules linked to each other by a peptide bond through a condensation process. The water molecule is removed. Further condensation may add additional amino acids to form a polypeptide chain. amino acid + amino acid condensation dipeptide + water dipeptide + hydrolysis of water amino acid + amino acid PHOTO 4.5 Each dipeptide can be decomposedAcids from foods rich in protein hydrolysis. There are about 20 types of amino acids in nature. Various types of ICT 4.3 polypeptide molecules can be made from 20 types of amino acids. Test: Test your acids. This is because each type of protein is different in its perception of amino acids in the acidic sequence of their polypeptide chain. Proteins Role of proteins in the cell Proteins are used in building new cells, repairing damaged tissues, and synthesizing enzymes, hormones, antibodies, and hemoglobin. Proteins also make building blocks like keratin in skin, collagen in bones, and myosin in muscle tissue. The breakdown of proteins or polypeptides by digestive enzymes gives us energy for our daily activities. Polypeptides can be broken down into amino acids. This amino acid is then reused to make the protein molecules needed by the body. You can read more about protein digestion in Chapter 9. 4.3. Formative Practice 1. Name the monomers of proteins. 4. Explain the effects of dietary protein deficiency on hair condition. 2 Name the reactions that occur in a person with nails. a dipeptide. 3 Name two meanings of proteins.76 4.3.1 4.3.2 4.3.3 4.3.44.4 Lipids Biological lenses Lipids are naturally occurring hydrophobic compounds found in plant and animal tissues. Like carbohydrates, lipids are made up of carbon and hydrogen and can be tested with oxygen elements, but with a much higher ratio of hydrogen atoms than the oxygen-ethanol emulsion test. atoms. Formation & Lipids are insoluble in water but soluble in other organic solvents, for example alcohol, ether and chloroform are given for a white emulsion. A positive result for the presence of lipids. Types of lipids CHAPTER 4 ICT 4.4. Types of lipids include fats, waxes, phospholipids and steroids. Quiz: Test your understanding of fats and lipids Fats and oils are triglycerides. Triglycerides are esters formed by the condensation of one molecule of glycerol with threefrom fatty acids. As a result of the hydrolysis reaction, triglycerides can be hydrolyzed again to fatty acids and glycerol. Glycerins are a type of three-carbon alcohols containing three hydroxyl groups (ΔOH). condensation + + 3H2O hydrolysis glycerol fatty acids triglycerides water There are two types of fatty acids, saturated fatty acids and unsaturated fatty acids. The similarities and differences between saturated and unsaturated fats are listed in 4.1. and 4.2. on the table. PHOTO 4.6. TABLE 4.1. Similarities Between Saturated and Unsaturated Fats Lipid-Rich Foods Similarities Both are made up of the elements carbon, hydrogen and oxygen. Both contain glycerin and fatty acids. Both contain non-polar molecules.4.4.1 4.4.2 4.4.3 77. 4.2. TABLE Comparison of saturated fats O =fâaCtsâaCHHnâdHCHuânUsHHCaânUsHHCaânUsHHCaântuHHCâHfantuHCHrâ Saturated fats - C-C C C C C C HâO â H â H â Hâ Hâ Hâ H have at least one carbon double bond in fatty acids fa. between coal. O= H H H H H H H H H H H H H H CHâCHâHCHâHCHâHCHâHdCbo=Combined CbdHlâeHCHâHCHâHCHâHCHâHCHâHCHâHCHâ. H C–C–C–C–C–C–C–C–C–C–C–C–C–C â¼ C HH O H H H H H H H H H H H H O â â EchDayxodrisbnrtooHoigOânntO =efasonCotroHâmalCimdtHâHocsCfmoHhâHaresCmrHmâeHbCaiesHâ chtaccatharâ lhuoubcrohsa homectne = dadtcelssl.hm bhwcophâ ihtnehcdhrâ haasctdhu bhdrceehiâ tth.iwcohâ nhecaehâ hlnchâ h dubultâs saites joprojâm can přijímají jeden nebo další hydrogen atoms because carbon atoms są nienasycone. It is in liquid form at room temperature. Source: Olive and Fish Oil Our World of Biology Wax Saturated fat is a wax containing one alcohol molecule that binds to another molecule that is not beneficial to the health of fatty acids and is resistant to water. because it raisesBlood phospholipids in the form of low-density phospholipids are the main component of plasma membranes and consist of lipoproteins (LDL). from a glycerol molecule connecting two fat molecules. Increases acid and phosphate groups. risk of heart attack. Saturated fat can also increase the risk of diabetes. Steroids are lipids that do not contain fatty acids. Examples of steroids include cholesterol, testosterone, estrogen, and progesterone. Importance of lipids in cells Fats act as energy reserves in animals. In addition, fat also acts as a lining to protect internal organs and act as thermal insulators for animals. Waxes are an important part of the cuticle that covers the epidermis of the leaves and the sebum produced by our skin. The function of the glycolipid is to ensure the stability of the plasma membrane and support the process of cell identification. Cholesterol is important for the synthesis of steroid hormones. 4.4. Building practice 3. State your opinion on the use of synthetic steroids for building 1. State the elements in lipids. body muscles. 2 Name the types of lipids.78 4.4.4 4.4.54.5 Nucleic acids UNIT 4 ICT 4.5 Nucleic acids are one or two polymer chains consisting of nucleotides Activity: production of monomer. Nucleic acids are made up of the elements carbon, hydrogen, oxygen, nitrogen and phosphorus. Each nucleotide consists of a pentose DNA model sugar (a sugar with 5 carbon atoms), a nitrogenous base, and a phosphate group, which are joined by a double helix in the condensation process (Figure 4.3). There are two types of pentose sugars, structural ribose and deoxyribose. The nitrogenous bases are adenine (A), guanine (G), cytosine (C), thymine (T) and uracil (U) in DNA. Double helix There are two types of nucleic acids: Structure • DNA Deoxyribonucleic acid (DNA) • Ribonucleic acid (RNA) Ribonucleic acid (RNA) contains the sugar ribose, while deoxyribonucleic acid (DNA) contains deoxyribonucleic acid.The basis of deoxyribonucleic acid (DNA) DNA consists of two polynucleotide chains that intertwine in opposite directions to form a double helix (Fig. 4.3). The nitrogenous bases in both polynucleotide chains match and are connected by hydrogen bonds. The nitrogenous bases of DNA are adenine (A), guanine (G), thymine (T) and cytosine (C). Adenine pairs with thymine and guanine with cytosine. TA phosphate group nitrogen sugar phosphate chain TA sugar pPCosphaGte chain phosphate group nitrogenous base hydrogen AT bonds between casotogenic base anucleotide TA deoxyribose sugar TA CG deoxyribose sugar CG (aFsiegsurfoer4.R4)N. And there's adenine, guanine, cytosine, and sugar and uracil. HThymNine in DNA is replaced by uracil in RNA. Phosphate Backbone The three main types of RNA are messenger RNA (mRNA), ribosomal RNA (rRNA), and transfer RNA (tRNA). These three RNAs are involved at the nitrogen base in the process of pProuteainsynnttahesis. DIHmo-ypNoOuokrntoawNnwcheaNt Hodefternmuincelsethice cahacraidctesrisitnicsaofcaen lolrganism such iens feoyrNemcaHotlio2ounNr aonrdhaeidgehtte?rmDNinAan is of great importance as a carrier of hereditary traits in living organisms. DNA contains the genetic codes carried by the nitrogenous bases (A, G, C, and T) for the seistsynsthiensias polypeptides that make up proteins. The genetic code is written as a series of three bases that determine the iAsseUqtHuhtGeeHnccooeddooefnaf(omNbNrianHsmoee2astechgiidousneimnnceep:raoamtdeieinnosintaeoc, ibuderas(Fycinilgtuhanreesdis4ge.ud5a)..nFiTonrheee)xotahmrepmele-Rb,NtahsAee tsreaqnuselnatcNeed iinnOtDo NthAe codons which are then transferred into amino acid sequence into mRNA. form a single theanam polypeptide. TinhoisUamcreiadanssieltqhuaetnthcee nucleotide sequence in DNAthe corresponding HondingOprotein. in a polypeptide chain including H N-H DNA N transcription NA RNA proteins from nucleic acids Chromosomes are made up of strands of DNA polynucleotides wrapped around a protein called a histone. Histones do not carry hereditary information. 80 DNA molecules combine with histone proteins to form nucleosomes. Nucleosomes intertwine to form the structure of the chromosome. 4.5.3 4.5.4 4.5.5 nitrogen base pairs HISTONE DNA adenine (A) thymine (T) gene NUCLEOSOME guanine (D) CELL cytosine (C) AP CHROMOSOME nucleus two types of nucleic acids. 3 Explain why the structure of RNA is shorter than that of DNA. 2 List the components of a nucleotide. 4 Explain the possibility that there is no nucleic acid in the cell. GENERAL CHEMICAL COMPOSITION IN THE CELL Water Carbohydrates Proteins Lipids Nucleic acids Properties: Type: Amino acids • Type: Fats, Waxes, • Any nucleotide polarity of water, • Monosaccharide: Dipeptides Phospholipids and consists of polypeptides with specific heat capacity, steroids, pentose, sugars, glucose capacity, fructose nitrogenous water, gluten and galactose • Comparison of base and strength and • disaccharide: between the phosphate group of maltose, sucrose of saturated fat and water and lactose of unsaturated fat • type: • polysaccharide: - DNA starch, glycogen - RNA and cellulose 81Self-Analysis Did you learn the following important concepts? • Properties of water and their importance in cells • Elements of proteins and their importance in cells • Types of lipids and their importance in cells • Structure of the nucleusand its importance in cells • Formation of chromosomes. Final Exercise 4 1 Wax is a type of lipid. Wax can be found in the cuticle of leaves, fruits and seeds. Explain the function of wax on the skin of a fruit. 2 In the picture. 1 shows the nucleotide. (a) Name the components P, Q and R. (b) Complete Figure 2 to represent the entire DNA molecule. P Q R FIGURE 1 FIGURE 2 FIGURE 3 State the differences between (a) the structure of a DNA molecule and a polypeptide molecule (b) the structure of DNA and RNA824 (a) How does water help respiration and digestion? b) What properties allow aquatic organisms to live throughout the winter? 5 In the picture. 3 shows the reaction between lipid formation and degradation. (a) (i) List the parts labeled K, L and M. (ii) Name the processes P and Q. (b) Fatty acids are divided into saturated + + H2O fatty acids and unsaturated fatty acids. Q. List four differences between K LM saturated fat and unsaturated fat. FIGURE 3 Essay Questions 6 Figure 4 shows the formation of carbohydrates during photosynthesis. Carbohydrates are a type of macromolecule. a) Explain the importance of macromolecules in organic compounds. b) Explain the formation of polysaccharide. c) Discuss the importance of organic compounds in the cell. oxygen sunlight Enrichment 7 Ariff follows a low carb diet. Suggest the carbon dioxide that should be done to reduce the starch content of potatoes during cooking. water 8 The results of biological research are widely used in various industries to improve quality and productivity, as well as to solve problems. Among the research FIGURE 4 used by environmentalists are biodegradable plastics and green batteries. A group of scientists from Malaysia has succeeded in inventing environmentally friendly batteries using seaweed pulp. How do you think research on the chemical elements in algae has helped scientists invent environmentally friendly products? Completedby scanning the provided QR code you will receive 83CHAPTER Metabolism5 and Enzymes • DID YOU KNOW... Which types are in the cell? metabolism take place What is the purpose of the enzyme obtained from fungi • Whfehaacettnaiozrynem?tehcdhaitrsacmteercitshtaicnsis? What factors influence the reaction of enzymes? • eWnhzaymt isesthoenaepvpelrcydataioynlifef?845.1 Metabolism 5.1.1 Define metabolism. 5.1.2 Name the types of metabolism in the cell: Metabolism 5.2.3 Describe the names of enzymes when Aase is added to their substrates 5.2.4 Characterize the general properties of enzymes 5.2.5 Indicate the involvement of specific organelles production: intracellular enzymes 5.2.6 • extracellular enzymes Explain the mechanism of action of enzyme 5.2.7 using the key-lock hypothesis. 5.2.8 Interpretation of energy diagrams to explain mechanism of enzyme action. Correlate the mechanism of enzyme action with changes in the following factors: • Temperature 5.2.9 • pH • Substrate concentration • Enzyme concentration Design and conduct experiments to study the effect of temperature and pH on enzyme activity. Amylase and pepsin 5.3 Use of enzymes in everyday life 5.3.1 Explain the use of enzymes in everyday life using examples. 855.1 Metabolism Metabolism refers to all chemical reactions that take place in a living organism. Metabolic processes involve the conversion of food into energy in the form of ATP and the formation of carbohydrates, proteins, lipids and nucleic acids. Types of metabolism in the cell There are two types of metabolism: catabolism and anabolism. Catabolism is the process of breaking down complex substances into simple substances. This reaction releases energy. For example, the breakdown of glucose during cellular respiration to generate energy. Mostly catabolic reactionsas follows: A B+C (substrate) (products) Anabolism is the process of synthesizing complex molecules from simple molecules. This reaction consumes or absorbs energy. For example, the formation of glucose during photosynthesis. In general, anabolic reactions are as follows: A+B C (substrate) (product)5.2 The biological lens of enzymes In the cell, biochemical reactions proceed at a high rate to protect living organisms. Alcanivorax processes. Biochemical reactions in cells can happen quickly because Borkumensis bacteria have enzymes that help speed up reactions. Produces hydroxylase enzymes for breakdown The enzyme is an organic catalyst composed primarily of proteins and oil spills found in the sea and produced by living cellular organisms. However, not all enzymes are synthesized from proteins. Fabrics necessary for epnrozduyccmts e-product fabric. The reactions are called substrates. Substrates bind to enzymes at a substrate-specific site known as the active site, forming an enzyme-substrate complex (Figure 5.1). complex complex 5.1. PAINTING. Enzyme-Substrate Complexation 5.1.1. 5.1.2. 5.21.1. 5.21.2. Scope of Enzyme Nomenclature In the 1960s, the International Union for the Collection of Biochemical and Molecular Information introduced an enzymatic biology (IUBmenclature) that defines an enzyme's substrate or the reaction it catalyzes. The name of the enzyme comes from the nomenclature by adding "ase" to the name of the substrate it catalyzes. a typical example of an "ase" attached to a substrate is the lactase enzyme, which catalyzes the hydrolysis of lactose. International Union of Biochemistry and Molecular Biology Lactose + Water Lactase Glucose + Galactose (IUBMB). Submit it here However, there are also some enzymes that do not follow this class naming system, notablydiscovered before the introduction of a systematic naming system. Some examples are trypsin, pepsin and renin. General properties of enzymes Enzymes act quickly. Enzymes are only the structure needed for small enzymes, remains unchanged and can be reused. is not destroyed after the reaction. Enzymes are biological catalysts GENERAL INFORMATION that speed up enzymatic reactions. PROPERTIES are specific. Just a biochemical substrate suitable for a reaction. C ENZYMES are formed entirely with an enzyme in the active site. Some enzymes require enzymatic activity. Enzymatic activity can be combined. Cofactors have slowed down or stopped working more efficiently. Example of enzyme inhibitors. Most reactions are cofactored by vitamin B, for example, the inhibitor is catalyzed by enzymes and magnesium ions. Heavy metals such as lead are reversible. or mercury.5.2.3 5.2.4 87Biological lens Intracellular and extracellular enzymes are produced "Glycolysis" Enzymes synthesized by the cell for its own use are called intracellular enzymes. For example, the enzyme hexokinase - glucose - is used and "lysed" in the process of glycolysis during cellular respiration. as extracellular enzymes. For example, the enzyme trypsin is produced by pancreatic cells from glucose and secreted into the duodenum to cleave hexokinase enzyme polypeptides. To generate energy. How are extracellular enzymes formed? Production of enzymes and pyruvate. it includes several specific cellular components (Figure 5.2).1 2 3 The ribosome is the site of protein synthesis when protein synthesis is complete. the ribosome enters the lumen of the rough endoplasmic reticulum, through which the forming membrane rudiments are transported. transport bubbles. Nuclear membrane protein secreted by nuclear pore 6 as crude endoplasmic enzymes.plasma membrane 2 5 1 ribosome secretory vesicle Golgi apparatus 3 smooth protein endoplasmic reticulum 4 transport vesicle In the Golgi apparatus secretory vesicles contain proteins, proteins are modified to move towards the plasma, move towards Golgi enzymes and they are secreted into the membrane and fuse with it in the apparatus, and then fuse with secretory vesicles that secrete extracellular enzymes. with this. formed by the upper part of the Golgi apparatus. FIGURE 5.2. Production of extracellular enzymes88 5.2.5. Mechanism of action of AR enzymes. Lock and key hypothesis. Most enzymes are complex proteins consisting of polypeptide chains folded into three-dimensional structures. This three-dimensional structure has an active site with a specific configuration that complements a specific substrate molecule. The binding of the substrate molecule to the active site of the enzyme is specific, as is the connection between the key and the lock (Fig. 5.3). The enzyme is represented by the "lock" and the substrate is represented by the "key". ssuubbsstrstaruatbetestrate pprorodduupccrtostsductsenergy in system 2 Substrate combines with the CHAPTER 5 active site to form enzyme-substrate complex.eennzzyyymmemeneezyme EEnnzzyymEmenezyme 3 A reaction takeesnnzpzylymaemcenezyamnde a product is ssuubbsstrstaruatbetesctcroaomtmeppcleloexmx plex 1 The specific substrate FIGURE 5.3 The â˜lock and keyâ!.fi hypothesis created The product then leaves the active site after the reaction is complete. brings the enzyme closer. Most reactions in the cell require a large amount of activation energy. Activation energy is the energy needed to break a bond in a substrate molecule before starting a reaction. Enzymes work by lowering the activation energy (Figure 5.4). This speeds up the rate of biochemical reactions in the cell. activation energy Index: no enzyme reaction no enzyme reaction with enzyme activation energy with enzyme reagent products FIGURE 5.4the presence of enzymes reduces the activation energy of the reaction 5.2.6 5.2.7 895.2.6 5.2.7 Enzyme action mechanism and factor changes Many factors affect the enzyme action mechanism. The chemical bonds of enzymes can be easily modified by chemical transformations and physical conditions. Among these factors are temperature, pH, enzyme concentration, and substrate concentration. Effect of temperature on reaction rate 2 5.5. Figure 1 shows the effect of temperature on the rate of reaction 1 optimal temperature biochemical reaction controlled by enzymes. 31 • At low temperature, the rate of enzyme-catalyzed reaction is slow at 37 °C. 10 20 30 40 50 60 • As the temperature increases, the kinetic energy of the molecules and enzymes of the temperature control medium (°C) also increases. This increases the effective frequency of collisions between substrate molecules and enzyme molecules. to the rate of enzyme reaction • The rate of reaction between enzymes and substrate molecules increases. • For every 10°C increase in temperature, the speed of the enzyme-driven reaction doubles until the optimum temperature is reached.2 At the optimum temperature, the enzyme reaction is at its maximum. The optimum temperature for enzyme reactions in the human body is about 37°C.3 Once the optimum temperature is reached, any further increase in temperature will rapidly decrease enzyme activity until it stops at 60°C. • Enzymes are denatured at this temperature because the chemical bonds in enzyme molecules are broken at extreme temperatures. • Enzymes cannot maintain a three-dimensional shape. The active center of enzymes changes. The substrate does not complement the enzyme active site. pH Optimum Effect of pH on pH Optimum • Enzyme activity is affected by salivary amylase trypsin pH of the surrounding solution. Generally optimal pH and most enzymes all enzymesmost effective for pepsin in animal cells optimal reaction rate • Most enzymes are most active in the pH range of 6-8. For example, salivary amylase 01 2 3 4 5 6 7 8 9 10 works at pH 6.8. pH • However, there are exceptions. FIGURE 5.6 Influence of pH on Enzyme Activity For example, the pepsin enzymes in pepsin, salivary amylase, and gastric trypsin operate in an optimal pH range of 1.5 to 2.5. By contrast, the enzyme trypsin90 in the duodenum works well only in an alkaline environment at about pH 8.5 (Fig. 5.6). 5.2.8. By changing the pH value, the charge of the denatured enzyme molecule (H+ ion) on the enzyme active center and the surface of the substrate changes. As a result, the normal enzyme-substrate enzyme-molecule complex cannot be formed. FIGURE 5.7. Denatured enzyme molecule... When the pH of the medium returns to its optimal value, the charge of the active site is restored. The enzyme returns to normal function. A large change in pH will break the structural chemical bond and change the shape of the active site of the enzymes. Denatured enzyme (Fig. 5.7). Influence of substrate concentration. When the enzyme concentration is constant and the substrate concentration increases, the reaction rate controlled by the enzymes also increases, resulting in an increase in the amount of product formed (Figure 5.8). Maximum value 1 • As the substrate concentration increases, the probability of 10 2 effective collisions between 0.5 1 molecules of substrate and enzyme increases. • Reaction speed continues to increase until it reaches its maximum. The reaction rate is constant. 2 • At maximum concentration, enzyme concentration becomes the limiting factor. The rate of the reaction can only increase if the effect of substrate concentration in the enzymes on the rate of the enzyme reaction is increased.After reaching the maximum level, all active sites of the enzyme are saturated with the substrate and are involved in the catalytic reaction under the influence of the concentration of the enzyme.1 As the rate of the enzymatic reaction increases, the rate of the enzymatic reaction increases due to the maximum level. Level, 3 more active sites ready for 1 catalytic action. Enzyme2 When the concentration of an enzyme is doubled in a concentration reaction, the amount of enzyme substrate is converted to products at the same concentration, as shown in Fig. 5.9. on the picture. The effect of the amount of enzyme substrate converted to products on the rate of the enzymatic reaction is doubled at one concentration. a condition for excess substrate.3 At maximum speed Substrate concentration up to the limiting factor. The reaction rate can only be increased by adding more substrate. Enzyme to optimum temperature. The rate of the enzymatic reaction decreases after reaching the optimum temperature. Ice and filtered water glass, test tube, syringe, pipette, glass rod, grooved white tiles, thermometer, Bunsen burner, stand, wire cloth, test tube stand, graduated cylinder and stopwatch. Procedure 1 Using a syringe, add 5 ml of 1% starch suspension to each tube labeled A1, B1, C1, D1 and E1. 2 Using another syringe, add 2 ml of the amylase enzyme solution to each tube labeled A2, B2, C2, D2, and E2. 3 test tubes A1 and A2, B1 and B2, C1 and C2, D1 and D2, E1 and E2 are placed in 5, respectively.Water baths with a fixed temperature of 20°C, 30°C, 40°C, 50°C and 60°C. 4 Incubate all tubes for 5 minutes. 5 Meanwhile, prepare a dry, white grooved tile and place a drop of iodine solution on the tile. 6 After 5 minutes of incubation, pour the starch suspension from tube A1 into tube A2. Stir the mixture with a glass rod. Start the timer immediately. 7 With a pipette, remove a drop of the mixture from tube A2 and immediately drop it into the first groove of the tile containing the iodine solution (zero minutes is considered the first groove). 8 Repeat the iodine test every 30 minutes. After each sampling, rinse the dripping water bath with water from the beaker. Record the time required for the hydrolysis of each starch to be completed, i.e., H, the temperature time at which the mixture retains a brownish-yellow color in the iodine solution test. 9 Keep all test tubes submerged in their respective water baths during the experiment. Repeat steps 5-8. operation for each pipe pair B1/B2, C1/C2, D1/D2 and E1/E2. Scene 5 ml 2 ml amylase solution suspension92 5.2.910 Record the results in the appropriate table. Plot the rate of the enzymatic reaction (min-1) as a function of temperature (°C). Results Temperature Starch hydrolysis time Rate of reaction (°C) to completion (minute) (1 minute) 20 CHAPTER 5 30 40 50 60 Discussion 1 Why must the tubes be incubated for 5 minutes in an appropriate water bath before starting the experiment? 2 What is the effect of amylase on starch? 3 What is the function of iodine solution? 4 Using the drawn graph, explain the effect of temperature on enzyme activity. Conclusion Is the hypothesis accepted? Suggest an appropriate conclusion for this experiment. 1.2 5.2 Activity Activity study of the effect of pH on the activity of the enzyme pepsin Experimental task What is the optimal pH response of the enzyme pepsin? Hypothesis pH 2 is optimal for pepsinReaction. Manipulated variables: pH of the medium Reaction Reaction: Clarity or turbidity of the mixture Reaction Fixed: Protein concentration, concentration of the pepsin solution and temperature of the reaction medium Materials Protein suspension (egg white), 1% pepsin solution, 0.1 M hydrochloric acid, 0.1 M hydroxide water bath at 37 °C, indicator paper and distilled water Apparatus Beaker, dropper, thermometer, test tube, 5ml syringe (without needle), stopwatch, Bunsen burner, tripod, wire mesh, thermometer and test tube rack 5.2.9 93 Method 1 Preparation three tubes and label them P, Q and R. 2 Using a syringe, add 5 ml of albumin suspension to each thermometer tube PQ. R 3 Add the following solution to each test tube: Test tube ➢ P: 1 ml of 0.1 M hydrochloric acid + 1 ml of 1% pepsin solution in a 37 °C water bath ➢ Q: 1 ml of distilled water + 1 ml of 1% pepsin solution • R : 1 ml of 0.1 M sodium hydroxide + 1 ml of 1% pepsin solution 4 Dip a piece of indicator paper into each test tube and record the pH of the mixture. 5 Place each tube in a water bath at a constant temperature of 37°C for 20 minutes. 6 Observe the state of the mixture at the beginning of the experiment and after 20 minutes. 7 Record the results in the table Results Test tube pH Clear or cloudy P 0 minute After 20 minutes Q R Discussion 1 Why should the test tube be incubated in a water bath at a constant temperature of 37°C? What effect does pH have on the effect of pepsin on albumin? 3 Discuss the result obtained for tubes P, Q and R. Conclusions Was the hypothesis accepted? Suggest a suitable conclusion for this experiment. 5.1 Formative Practice 1 What happens when ribosomes fail in a pancreatic cell? 2 Why is it necessary to maintain body temperature at 37 °C? What is the optimum pH for the action of the enzyme pepsin? 4Y is an enzyme that catalyzes the hydrolysis of sucrose into glucose and fructose. What is enzyme Y?94 5.2.9 5.2.9

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