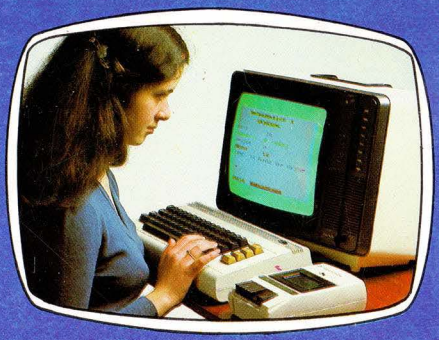
VIC-20
COLOUR COMPUTER

cassette
SOFTWARE



GCE 'O' LEVEL/CSE REVISION PROGRAM

BIOLOGY

170 Questions • 6 Sections
All Topics Covered

A Comprehensive VIC-20 Revision Program for GCE 'O' Level and CSE Examinations

Tests your knowledge across the syllabus

Highlights areas requiring further revision

Automatic Scoring and Timing

'Beat The Clock' Test Option

Editorial material supplied by ICS International Correspondence Schools

This Program requires the use of an 8K or 16K RAM Expansion Cartridge in the VIC-20

Printed in England

GCE 'O' LEVEL/CSE REVISION PROGRAM

BIOLOGY

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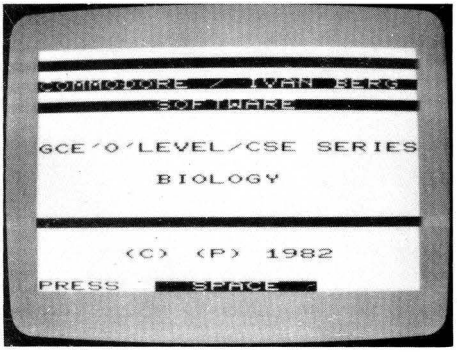
Loading and Running

1. **Switch off VIC to clear the memory completely and make sure your 8K or 16K RAM Expansion Cartridge is plugged into the slot at the back of VIC before carrying out the following:**
2. Switch on VIC. Place the OPERATING SOFTWARE cassette in the cassette deck and ensure that the tape is rewound. (NOTE: the OPERATING SOFTWARE program is recorded twice on each side of the cassette for problem-free loading.)
3. Type LOAD "BIOLOGY" (don't forget the quotation marks) and press RETURN. VIC will respond with PRESS PLAY ON TAPE.
4. Press PLAY on the cassette deck and VIC will respond with SEARCHING FOR BIOLOGY then after a few seconds FOUND BIOLOGY LOADING. Loading will take a couple of minutes.

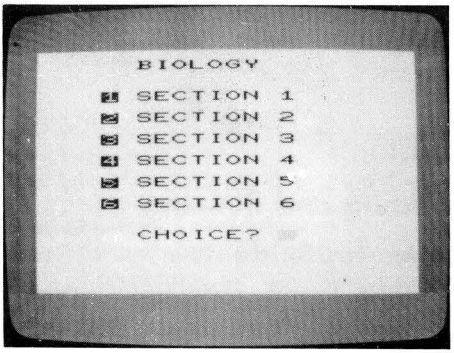
If VIC does not display FOUND BIOLOGY LOADING after approximately 30 seconds, carry out steps 1 to 4 again. If VIC does load Biology but presents LOAD ERROR on screen, carry out steps 1 to 4 again but DO NOT REWIND THE TAPE. Remember, the program is recorded **twice** on each side of the cassette.

Once the program is loaded VIC will display READY.

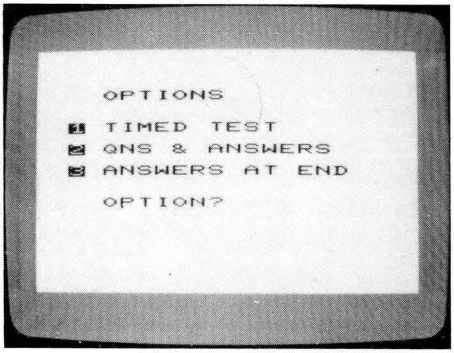
5. Type RUN and press RETURN.



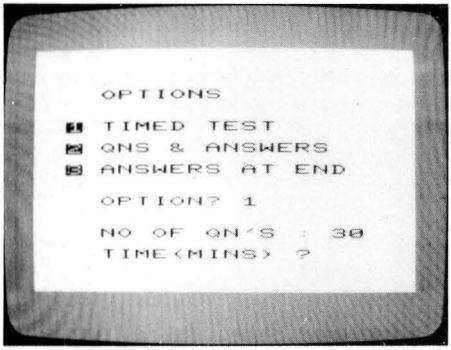
6. This is the program title. Press the keyboard Space Bar as requested.



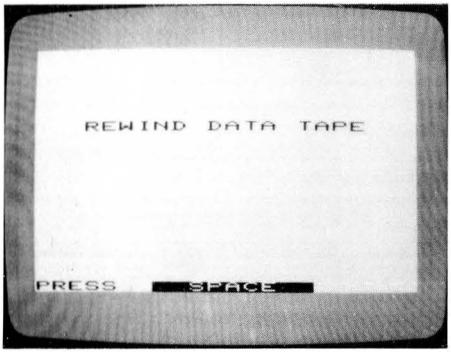
7. This is the program's Main Menu. The Biology questions are split into 6 sections for loading convenience and each section covers topics across the syllabus. Until you know the program it is best (and more efficient) to do your revision testing in sequence. So type 1, (for section 1) and press RETURN.



8. This menu gives you 3 Options. If you select 1, you'll be working against the clock, and VIC will not give you the correct answers until you have run out of time. If you select Option 2, VIC will give you the correct answer if your answer was incorrect and keep a check on the time you take to do the test. Option 3 will also time you but will not give you the correct answers until the end of the test. To see how the program works, select 1 and press RETURN.

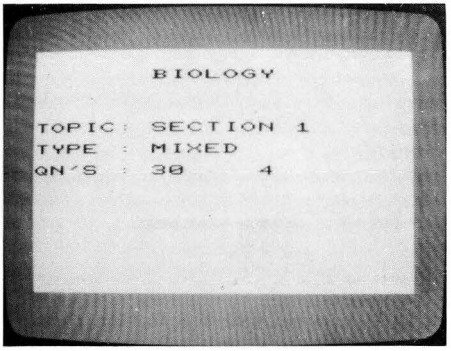


9. As we have selected TIMED TEST, VIC now gives us the number of questions in the test and requests a time limit (parts of a minute to be expressed in decimals, i.e. 3.5). So select a time, say 10 minutes, type 10 and press RETURN.

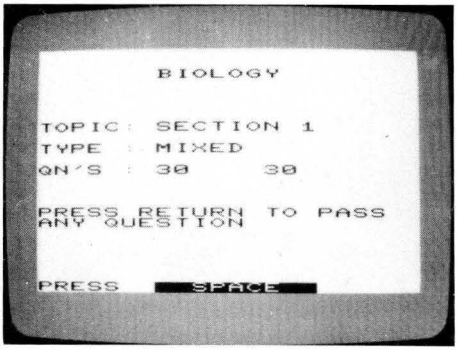


10. As Section 1 has not been loaded and used, VIC asks you to rewind the DATA TAPE. So take the OPERATING SOFTWARE cassette out of the cassette deck, replace it with the Biology DATA cassette and make sure it is rewound. Press the Space Bar as requested.

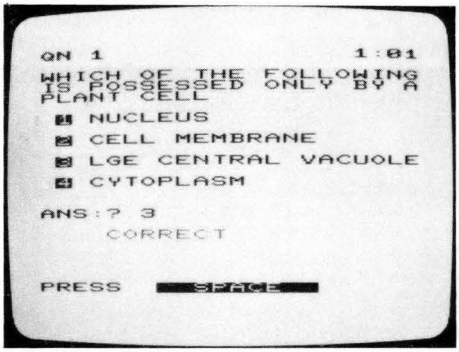
11. VIC now begins to search for Section 1, so press PLAY on the cassette deck as requested.



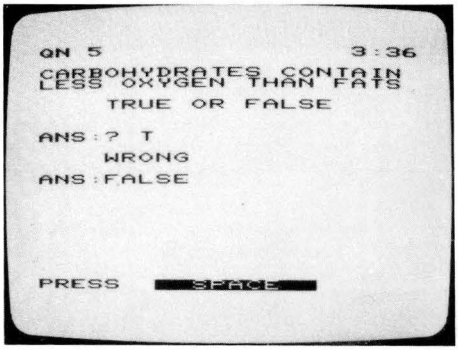
12. After approximately 20 seconds VIC has found Biology Section 1. As you can see the type of questions are MIXED, that is some *multiple choice*, some *true or false* and some requiring a *typed answer*. In Section 1 there are 30 questions and the figure on the right (in red) changes as the questions qre loaded into the VIC's memory.



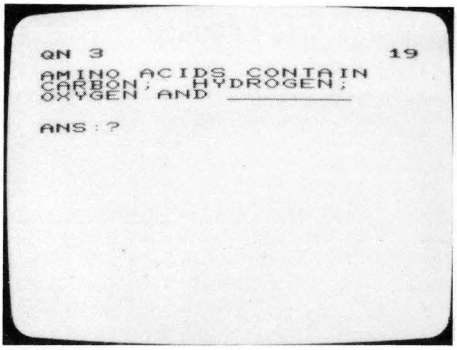
13. 30 questions are loaded. Note that you may press RETURN to pass any question. Press the Space Bar as requested and your revision test will commence.



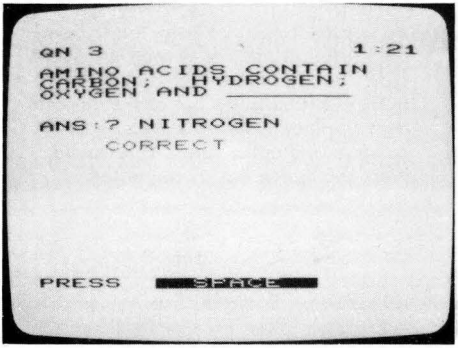
14. This is an example of a Multiple Choice Question. As you can see, 3 is the correct answer, and as Option 2 had been selected from the Option Menu (8 above) VIC responds with CORRECT. (NOTE: Always remember to press RETURN after answering a question).



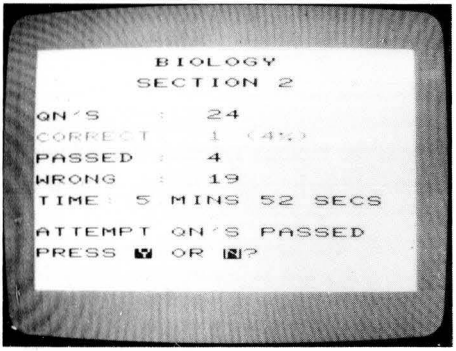
15. This is an example of a True or False Question. Note that you may answer with T for True or F for False.



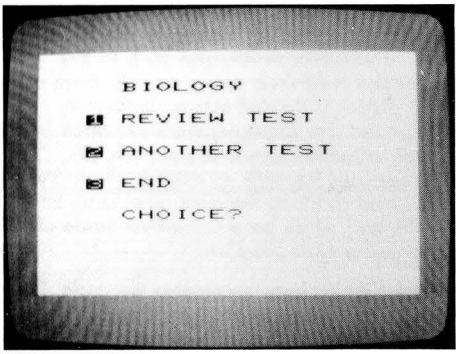
16. Here's an example of a question requiring a typed answer.



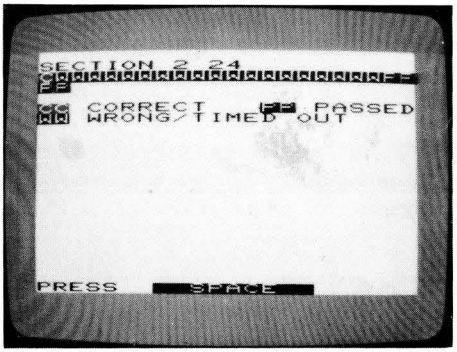
17. And here's the same question with the correct answer typed in.
NOTE: You may end the test at any time by typing END as your answer to the current question.



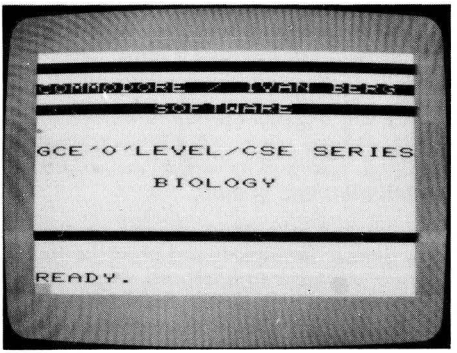
18. When you have completed the test or TIME OUT appears on the screen in a timed test, VIC will give you a summary of your results and the option to attempt those questions you passed on, again by typing Y or N in response to the prompt ATTEMPT QNS PASSED Y/N?



19. If you typed N (and pressed RETURN) VIC will display this end of test Menu. If you choose 1, you will review every question in the test, complete with its correct answer. If you choose 2, VIC will return you to the Main Menu for another test. (If you wish to do the same test again you will not need to load that section from the DATA cassette).



20. If you choose 3 END, then VIC will display this bar chart — and the more tests you do before choosing to END the program, the more helpful this chart becomes, as it displays all the results of all the tests completed. A look at this will soon tell you which sections need further revision.



21. This is the end of the program and VIC displays READY. If you wish to use the program again type RUN and press RETURN.

NOTES: As the cassette deck is under program control when the DATA cassette is in use, you can leave the PLAY key down on the cassette deck, and provided that the section requested has not been used before, VIC will load the questions automatically and stop the cassette at the end of the section. If you wish to go back to a section VIC will ask you to REWIND DATA TAPE.

NOTES FOR STUDENTS

This VIC–20 program tests your knowledge across the Biology syllabus. The following information should help you and it may be advisable to read through it before running the program.

Section 1
The Nature and Variety of Living Organisms

All living organisms are made up of one or more cells. All cells have a common basic structure: they possess a nucleus which controls all chemical reactions in the cell; cytoplasm in which these chemical reactions occur; and a membrane which surrounds the cell and controls the entry and exit of materials. Plant cells possess chloroplasts which contain chlorophyll, a substance essential for photosynthesis. They have a cell wall made of cellulose and a large central vacuole.

All living organisms have the following characteristics in common: **feeding, respiration, excretion, response to stimuli, movement, reproduction and growth.**

Multicelled animals are divided into two large groups: vertebrates and invertebrates. Invertebrates have no backbone. A group of intervertebrates with similar characteristics is called a **phylum.** Simple invertebrates with only two cell layers belong to the phylum **Coelenterata.** Examples of Coelenterata are **hydra** and **sea anemones.** Both of these organisms possess specialised stinging cells called **nematocysts.** Earthworms, which have a body composed of many similar segments, belong to the phylum Annelida. Tapeworms, however, are parasitic worms which live in the gut and muscle tissue of mammals, and belong to the phylum **Platyhelminthes. Arthropoda** is the largest invertebrate phylum and contains animals with jointed limbs. This phylum is divided into four classes: **Crustacea** — crabs, lobsters and woodlice; **Insecta,** which all have three pairs of legs and a body divided into a head, thorax and abdomen, for example, springtail, locust, dragonfly, beetle, ant, butterfly; **Arachnida,** examples of which are spiders and scorpions; and **Myriapoda** which are arthropods with a long body consisting of many segments, each of which has one or two pairs of legs, for example, centipedes and millipedes.

Animals with backbones are called **vertebrates.** There are three classes of poikilothermic or cold-blooded vertebrates. These are (1) fish, which all breathe with gills and live in water; (2) amphibians, which all have moist skins and lay eggs in water; and (3) reptiles, which are land-living animals that breathe with lungs and have bodies covered by scales. There are two classes of Homoiothermic or warm-blooded animals. These are (1) birds, which all have feathers and lay eggs; and (2) mammals, which are covered with hair or fur, give birth to live young and feed their young on milk. Each of these classes is divided into a number of smaller sets. For example, there are three groups of fish (1) simple jawless fish; (2) cartilagenous fish such as dogfish, shark and skate; and (3) bony fish such as salmon, trout and herring which have a skeleton made of bone and a swim bladder.

Amphibians have a complex life cycle. The eggs hatch into an aquatic or tadpole form. Tadpoles breathe with gills and are herbivores. Ultimately, however, they undergo a fundamental change of form called metamorphosis during which they develop legs and lungs and become land-living carnivores.

Section 2
The Functioning of Living Organisms

(i) Nutrition

There are three groups of food which release energy when they are broken down in the cells of living organisms. These are (1) carbohydrates; (2) proteins; and (3) fats.

Carbohydrates are molecules which contain atoms of carbon, hydrogen and

oxygen. The ratio of hydrogen atoms to oxygen atoms of always two to one. The simplest carbohydrates are monosaccharides. Glucose is an example of a monosaccharide. Its chemical formula is $C_6H_{12}O_6$. Disaccharides such as sucrose consist of two monosaccharides joined together. Polysaccharides are long chains of monosaccharide molecules. Starch, cellulose and glycogen are examples of polysaccharides. Carbohydrates are the chief source of energy in living organisms. One gram of carbohydrate yields seventeen kilojoules of energy.

Proteins are molecules which contain atoms of carbon, hydrogen, oxygen and nitrogen. These elements are combined to form amino acids. Although they can be used as a source of energy (one gram of protein yields seventeen kilojoules of energy) they are more important in forming muscle fibres, enzymes and membranes.

Fats are molecules which consist of atoms of carbon, hydrogen and oxygen, but have proportionately less oxygen than carbohydrates. Fats consist of smaller molecules called fatty acids and glycerol and are stored in the body for two reasons (1) as an energy reserve (one gram of fat yields 39 kilojoules of energy); and (2) as an insulating layer to prevent heat loss.

As well as the three groups of energy-giving foods there are another three food groups which are essential to living organisms. These are minerals, vitamins and water. In humans, minerals are required for the normal functioning of the body: calcium is necessary in bones and teeth; iron for the manufacture of haemoglobin; iodine for the hormone thyroxin which is produced by the thyroid gland, and phosphorus is an essential component of adenosine triphosphate, DNA and bone. The main vitamins are the following: A, found in milk, egg yolk, cabbage and carrots, is needed for growth and eye function; B, found in yeast, wheat germ, peas and beans, is important in the chemical reactions that release energy from food; C, found in citrus fruits, is needed for proper wound healing; and D, found in milk, egg yolk, and liver, is manufactured in the skin by the action of sunlight. It is necessary for the absorption of calcium and phosphorus by the small intestine. Vitamins A and D are fat soluble and are stored in the liver. For this reason the daily requirement of these vitamins is very low. Vitamins B and C are water soluble and so cannot be stored.

In order that food can reach the body cells where it is required it must first be broken down into small soluble molecules. In this form it is able to pass through the gut wall into the bloodstream. This process is known as digestion. The digestion of food is controlled by enzymes. These are proteinaceous biological catalysts. Enzymes are specific, each one catalysing only one reaction or type of reaction. Each enzyme has an optimum pH and temperature. In the human body this optimum temperature is 37 degrees Celsius but the pH varies. For example, salivary amylase works best at pH 7, pepsin at pH 2 and lipase at pH 8.5. In most mammals, teeth are used to break up food so that a large surface area is available for the enzymes to work upon. According to their diet, mammals have the following types of teeth in varying numbers and shapes: incisors, canines, premolars and molars. Herbivores, such as sheep and cows have no incisors on the upper jaw and have broad ridged molars capable of grinding down the cellulose which forms a large part of their diet. Carnivores such as cats and dogs have prominent canines and sharp pointed molar or carnassial teeth. The teeth of omnivores, such as humans, show little specialisation.

In the mouth food is masticated by the teeth and mixed with saliva which contains the enzyme amylase. This enzyme breaks down starch. Food is then forced down to the stomach through the oesophagus by a process of muscular contraction called peristalsis. A circular muscle called the cardiac sphincter controls the entry of food into the stomach. Here food is mixed with gastric juice which contains the enzymes rennin and pepsin as well as hydrochloric acid. The muscular walls of the stomach mix food forming a liquid called chyme. The pyloric sphincter muscle relaxes allowing food to pass into the duodenum. Here fluid from the gall-bladder called bile which is made in the liver is added to the food. This fluid emulsifies fats, allowing them to be digested by the enzyme lipase which is produced in the pancreas. The food then enters the ileum where the final processes of digestion take place. The product of the digestion of carbohydrate, glucose, passes through the gut wall into the bloodstream along with amino acids which are the digestive product of protein. Fats are finally broken down into fatty acids and glycerol and these substances

enter the lymphatic system. The surface area of the small intestine is greatly increased by infoldings called villi. Undigested food passes into the colon where water is absorbed. Eventually semi-sold waste called faeces is expelled through the anus.

Plants are able to manufacture glucose by a process called photosynthesis. In order to do this they require carbon dioxide from the air and water from the soil. The light energy which drives this reaction is trapped by the pigment chlorophyll. This is found in cell organelles called chloroplasts which are most numerous in the palisade mesophyll cells of a leaf.

(ii) Respiration

In both plants and animals the release of energy from foods such as glucose is known as respiration. This process takes place in all living cells. Where glucose is broken down without the presence of oxygen this is known as anaerobic respiration. If oxygen is present aerobic respiration will take place. When simple organisms such as yeast carry out anaerobic respiration the end product is ethanol, but in higher animals muscular anaerobic respiration produces lactic acid. The simple word equation for aerobic respiration is:

Glucose+Oxygen=Carbon Dioxide +Water+Energy

Aerobic respiration of glucose molecules produces 38 molecules of ATP while anaerobic respiration yields only two molecules.

Plants obtain the gases required for respiration and photosynthesis through pores called stomata which are mostly found in the lower epidermis of the leaf. Animals obtain oxygen in a numbers of ways. Because of their large surface area to volume ratio, protozoa obtain oxygen by diffusion through the cell membrane. Fish and other aquatic organisms possess gills over which a stream of water is passed. Mammals exchange gases by using lungs. All gas surfaces must be moist, have a large surface area and a good blood supply.

In order to obtain the water required for photosynthesis, flowering plants have an extensive root system. The surface area for absorption of water and minerals is increased by the presence of root hairs. Water enters the root hairs by a process called osmosis. Osmosis may be defined as the movement of water molecules through a semipermeable membrane from a weak solution to a strong solution. Water is transfered from the roots to the leaves in xylem vessels. These are dead tubular cells whose walls are thickened with lignin. This movement of water upwards takes place because of the continuous loss of water vapour through the stomata. This is known as transpiration. The transpiration rate is affected by humidity, temperature and air movements. Xylem cells are found in star shaped bundles in the roots of dicotyledons and on the inner side of oval vascular bundles in the stem. The products of photosynthesis, such as glucose, are transported through the plant in phloem. This is composed of living cells with perforated end walls which are thus called sieve tubes. Each phloem cell has associated with it a companion cell. The movement of food through a plant is called translocation.

(iii) The Circulatory System

Deoxygenated blood which has been round the body passes from the vena cava into the right atrium. The muscular walls of this chamber contract, forcing the blood into the right ventricle through the tricuspid valve. When the ventricle walls contract the blood is forced through the semi-lunar valve into the pulmonary artery. These vessels take the blood to the lungs where it becomes oxygenated. The blood is then returned to the left atrium through the pulmonary vein. From this chamber it passes through the bicuspid valve into the left ventricle which pumps blood into the aorta and round the body. Because of this the walls of the left ventricle are much thicker than those of the right.

(iv) Excretion

The waste products collected by the blood must be eliminated from the body. This is known as excretion. The principal substances which are excreted are carbon dioxide, urea and water. Carbon dioxide and water are formed in body cells as a result of respiration. Urea is formed in the liver as a result of the breakdown of excess amino acids. Excretion of these substances is essential in order to maintain a constant internal environment. This is known as homeostasis. The lungs remove carbon dioxide and water from the body. Water, salts and urea are excreted to a certain extent by sweat glands in the skin, but these substances are mainly removed from the body by the kidney. In humans, each

kidney contains about one million tubules, each of which ends in a hollow cup-shaped structure called the Bowman's capsule. Each capsule contains a network of blood capillaries known as the glomerulus. Small molecules such as water, urea, salts and glucose are forced through from the blood into the Bowman's capsule in a process called ultrafiltration. At the distal end of the tubule useful substances, mainly glucose, some salts and water, are selectively reabsorbed. The remaining solution, urine, passes through the collecting ducts and ureter to the bladder.

The amount of water reabsorbed by the kidney is controlled by antidiuretic hormone produced in the pituitary gland which is situated at the base of the brain. This is one of a number of glands in the body which secrete hormones directly into the bloodstream. They are known as endocrine glands. The islets of Langerhans in the pancreas produce insulin, a hormone which causes the conversion of glucose to glycogen. A lack of insulin leads to a condition known as diabetes. Another hormone, adrenalin, causes glycogen to be reconverted to glucose. Adrenalin is produced by the adrenal glands situated above the kidneys. Oestrogen and progesterone are hormones produced in the ovaries. They stimulate the development of female secondary sexual characteristics and prepare the uterus for implantation of the fertilised egg. The production of oestrogen is controlled by another hormone, FSH, which is manufactured in the pituitary gland. Although plants do not possess endocrine glands they do produce hormones. In plants these substances are important in controlling responses to external stimuli such as gravity and light. Responses of this sort are known as tropisms. Plant shoots grow towards light and are said to be positively phototropic. Roots grow towards gravity and are said to be positively geotropic. The hormones which bring about these responses are called auxins. An example of an auxin is indole acetic acid. Auxins stimulate cell elongation and cell division and can therefore bring about bending of the root or shoot in relation to the stimulus.

(v) The Nervous System

Animal responses to external stimuli are usually faster than those of plants since multicelled animals possess a nervous system. Vertebrates have a central nervous system consisting of the brain and spinal cord and a peripheral nervous system consisting of motor and sensory nerves. Sensory nerves conduct impulses from receptor organs to the central nervous system. Motor nerves conduct impulses from the central nervous system to effector organs. Examples of receptor organs are the eye, the ear and the skin. Effectors are organs such as muscles and glands. Nerve tissue is composed of nerve cells or neurones. The nuerone consists of three parts: (1) the cell body, containing the nucleus; (2) the axon, which is the fibre conducting impulses away from the cell body, and which is covered by an insulating layer of fatty material called myelin; and (3) dendrites, which are the small branches conducting impulses towards the cell body. Neurones are not actually connected to each other but are separated by a gap called a synapse. Transmission of an impulse can take place in only one direction across a synapse. Before an impulse can travel from a receptor organ along a nerve fibre it must be above a certain threshold value. The principal part of the central nervous system, the brain, in turn consists of three parts: the medulla, the cerebellum and the cerebrum. The medulla and the cerebellum are concerned with involuntary processes while the cerebrum controls voluntary actions. The simplest type of response to a stimulus is a reflex action such as the knee-jerk reflex. The stimulus generates an impulse which travels along a sensory nerve to the spinal cord. The impulse passes through a relay neurone in the grey matter of the spinal cord to a motor nerve also in the grey matter. The axon of the motor nerve conveys the impulse of the effector organ, which in this case is the thigh muscle, causing it to contract.

(vi) Movement

In man, three types of muscle are found: skeletal or voluntary muscle, involuntary or smooth muscle and cardiac muscle. Voluntary muscles usually bring about movement of the body. In order to do this they work in antagonistic pairs. One muscle, the flexor, brings about bending of the limb and another, the extensor, straightens it. An example of such a pair are the biceps and triceps muscles which move the forearm. In this case the biceps is the flexor and the triceps is the extensor. These muscles are attached to the bone by strong inelastic tendons. The fixed or non-moving attachment of the tendon is said to be the origin while the moving end is attached at the insertion. Movement of the skeleton can only take place

where there are joints between bones. Three main types of joint can be identified: (1) ball and socket joints, such as that between the femur and pelvis; (2) hinge joints, for example that between the humerus and ulna; and (3) gliding joints such as that between the bones of the wrist. Bones are held together at joints by tough elastic ligaments. To reduce friction between the bones at a joint the head of each bone is covered by a layer of articular cartilage. Further, a liquid called synovial fluid fills the space between the bones helping to reduce friction even more.

(vii) Reproduction

Reproduction may take place either asexually or sexually. In asexual reproduction no specialised reproductive cells are produced and only one individual organism is involved. Examples of asexual reproduction are binary fission in amoeba, budding in hydra, spore formation in bacteria and fungi, and vegetative reproduction in higher plants. This type of reproduction has several advantages. In may be very rapid and there is no necessity to find another individual of the same species before reproduction can take place. However, it has the disadvantage that all the offspring are genetically identical and so the possibilities of variation are limited. Sexual reproduction in animals requires the production of specialised reproductive cells called gametes. Fertilisation occurs when the nuclei of a male and a female gamete fuse to form a zygote. Animals living in water may have external fertilisation, where the fusion of the gametes occurs outside the body of the female. All land-living animals, however, have internal fertilisation. In man, male gametes called sperm are produced by the testes. They are passed into the epididymis and then to the sperm ducts where they are mixed with secretions from the prostate gland. Insertion of sperm into the body of the female takes places during copulation. At this time about one hundred million sperm cells are ejaculated into the vagina of the female. Female ova are produced in the ovaries and released every 28 days. Cilia and muscular contractions move the ovum down the Fallopian tube where, if sperm are present, fertilisation takes place. As soon as this occurs the zygote produces an extra membrane to prevent further sperm cells from entering. The fertilised egg, which has undergone rapid cell division, becomes implanted in the walls of the uterus. Part of the tissues of the developing embryo give rise to the placenta through which it obtains food and oxygen and disposes of nitrogenous waste and carbon dioxide. The gestation period of a human embryo is approximately 280 days.

Gametes possess only half the chromosomes of normal body cells. They are formed by the type of cell division known as meiosis. The type of cell division which gives rise to cells with the same number of chromosomes as the parent cell is mitosis. Gametes are haploid cells while normal body cells are diploid. Chromosomes carry hereditary information in the form of genes. The genes which an organism possesses, the genotype, will interact with the environment to produce the appearance of the organism, the phenotype. Mendel discovered, using pea plants, that the characteristics of an organism are controlled by a minimum of one pair of genes. It is now known that genes governing the same characteristic are found at the same position on homologous chromosomes.

For example, a pea plant may have two genes for round seeds. This is known as the homozygous condition. It may have one gene for round seeds and one for wrinkled seeds; this is known as heterozygous. Plants with this genotype would produce seeds all of which would be round. In this case the gene for round seeds is said to be dominant over that for wrinkled seeds. The gene for wrinkled seeds is said to be recessive. In order to produce wrinkled seeds a pea plant would have to be homozygous recessive, in other words to posses two genes for the wrinkled seed condition. If two pea plants heterozygous for seed shape were crossed, the offspring formed would have a phenotype ratio of three round to one wrinkled. In mammals, sex is determined by a pair of chromosomes called the X chromosome and the Y chromosome. Males possess an X and a Y chromosome, while females have two X chromosomes. Only the X chromosome carries genes.

Section 3
The Biology of the Environment

All living organisms are dependent on one another. Green plants manufacture food by converting light energy to chemical energy in photosynthesis. This energy is passed on to

herbivores, primary consumers, when they eat plants. The herbivores are in turn eaten by carnivores, the secondary consumers. This interrelationship of organisms is known as a food web. In any food web the living things present in greatest numbers are the producers or green plants. Those present in smallest numbers are the secondary or tertiary consumers. Thus a pyramid of numbers is formed. The physical environment in which a group of organisms lives is called a habitat. The organisms within the habitat are known as a community. Considered together, the habitat plus the community are said to form an ecosystem. In any ecosystem, essential organic materials and minerals such as nitrogen must be constantly recycled. Nitrogen is vitally important to all living organisms as it is an essential constituent of proteins. Plants take in nitrates from the soil which they convert into proteins. When the plant dies, or if it has been eaten by an animal, when the animal dies, saprophytic bacteria break down the protein to produce ammonia. This ammonia is then oxidised by the soil bacterium nitrosomonas to form nitrates. They in turn are further oxidised by another soil bacterium, nitrobacter, to form nitrates which may then be re-used by plants. Nitrosomonas and nitrobacter are known as nitrifying bacteria. Denitrifying bacteria, which live mostly in anaerobic soils, can convert nitrates to nitrogen gas. However, free-living nitrogen-fixing bacteria are capable of converting atmospheric nitrogen to nitrates. This process can also be carried out by nitrogen-fixing bacteria living in the root nodules of leguminous plants. For this reason leguminous plants are often grown as part of a crop rotation.

Conclusion

Once you have run the program and attempted all the questions you will know where your weaker points lie. Revise these areas thoroughly using your own text books together with the information in this booklet. Then try running the program again.

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