**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**The following section summaries have been adapted from our Coursebook. These will help you begin studying for the Cambridge Exam and/or our class cumulative exam. In addition, I have posted and will continue to post many helpful links on my Weebly. Use these links, the summaries below, and past classwork/assessments to review for the exams.**

**I strongly suggest making a one-page summary sheet for each section/chapter below. Please refer to the “How to Study for Biology Exams” orange sheet that I gave you earlier this year for more study ideas.**

**Cell structure- Ch. 1**

**1**The basic unit of life, the cell, can be seen clearly only with the aid of microscopes.

**2**The light microscope uses light as a source of radiation, whereas the electron microscope uses electrons.

**3**The electron microscope has greater resolution (allows more detail to be seen) than the light microscope, because electrons have a shorter wavelength than light.

**4**With a light microscope, cells may be measured using an eyepiece graticule and a stage micrometer.

**5**Using the formula ***M* = *I/A***, the actual size of an object (*A*) or its magnification (*M*) can be found if its observed (image) size (*I* ) is measured and *A* or *M*, as appropriate, is known.

**6**All cells are surrounded by a partially permeable cell surface membrane that controls exchange between the cell and its environment.

**7**All cells contain genetic material in the form of DNA, and ribosomes for protein synthesis.

**8** The simplest cells are prokaryotic cells, which are thought to have evolved before, and given rise to, the much more complex and much larger eukaryotic cells.

**9** Prokaryotic cells lack a true nucleus and have smaller ribosomes than eukaryotic cells. They also lack membrane-bound organelles. Their DNA is circular and lies naked in the cytoplasm.

**10** All eukaryotic cells possess a nucleus containing one or more nucleoli and DNA. The DNA is linear and bound to proteins to form chromatin. The cytoplasm contains many membrane-bound organelles providing separate compartments for specialised activities (division of labour). Organelles include endoplasmic reticulum (ER), 80S ribosomes, mitochondria, Golgi apparatus and lysosomes. Animal cells also contain centrioles. Plant cells also contain chloroplasts, often have a large, permanent, central vacuole and have a cell wall containing cellulose.

**11** In eukaryotes, cells may be further organised into tissues, organs and systems.

|  |  |  |  |
| --- | --- | --- | --- |
| **Organelle** | **Description** | **Function** | **Animal, Plant or Both** |
| CELL WALL | Rigid, tough, made of cellulose | Protects and supports the cell | Plant |
| CELL MEMBRANE | Thin, covering, protects cells | Protects the cell, performs active transport and passive transport, moves materials in and out of the cell, communication | Both |
| CYTOPLASM | Jelly like substance that contains organelles | Pads and supports organelles inside the cell. Moves by cyclosis | Both |
| NUCLEUS | Dense, ball shaped structure, contains DNA | Controls all of the cell’s activities | Both |
| NUCLEAR MEMBRANE | Thin covering over the nucleus | Covers and protects the nucleus | Both |
| NUCLELOUS | Small dark area in the nucleus | Produces ribosome’s | Both |
| CHROMATIN | In the nucleus, made of DNA and protein, contains genes | Provides instructions for the cells activities, (growth, reproduction) | Both |
| ENDOPLASMIC RETICULUM | Clear, tubular system of tunnels throughout the cell | Transports materials like proteins around the cell | Both |
| RIBOSOME | Small specks made of RNA. Found in cytoplasm or on the endoplasmic reticulum | Makes proteins | Both |
| MITOCHONDRIA | Location in the cytoplasm, bean shaped | Supplies energy or ATP for the cell through cell respiration using glucose and oxygen | Both |
| VACUOLE | Large open storage area, smaller in animal cells | Storage tank for food, water, wastes or enzymes | Both |
| CHLOROPLAST | Green structures that contain chlorophyll | Captures sunlight and uses it to produce food through photosynthesis | Plant |
| GOLGI BODY | Small bags with tubes connecting them | Packages and secrets proteins for use in and out of the cell | Both |
| LYOSOME | Small, round structures, containing enzymes | Digests older cell parts, food or other objects | Both |
| CENTRIOLE | Small cylindrical  | Used with the spindle apparatus during mitosis | Animal |

Table source: images.pcmac.org

**Section revision ideas:** Review Vocab/Key Concepts handout, review EOCQs, review Book reading, compare/contrast plant and animal cells and Eukaryotic and Prokaryotic cells, use online interactives to study functions of organelles, etc.

**Cell and nuclear division- Ch. 5**

**1**Growth of a multicellular organism is a result of parent cells dividing to produce genetically identical daughter cells.

**2**During cell division the nucleus divides first, followed by division of the whole cell.

**3**Division of a nucleus to produce two genetically identical nuclei is achieved by the process of mitosis.

**4**Mitosis is used in growth, repair, asexual reproduction and cloning of cells during an immune response.

**5**Although a continuous process, mitosis can be divided for convenience into four phases: prophase, metaphase, anaphase and telophase. The phase between successive nuclear and cell divisions is called interphase. Replication of DNA takes place during interphase so that the new cells will each have identical DNA.

**6**The period from one cell division to the next is called the cell cycle. It has four stages or phases: G1 is a growth stage, S (for synthesis) is when the DNA replicates, G2 is a second growth stage, and nuclear and cell division. G1, S and G2 are collectively known as interphase.

**7** In a life cycle involving sexual reproduction, the gametes have one set of chromosomes, a condition known as haploid. The cell produced by fusion of the gametes, the zygote, has two sets of chromosomes,

a condition known as diploid. In such a life cycle it is therefore essential that a type of nuclear division occurs which reduces the number of chromosomes from two sets to one set. This type of nuclear division is called meiosis and must take place at some point in the life cycle before fertilisation.

**8** All the cells in the human body are diploid, apart from the gametes, which are haploid.

**9** Cancers are a result of uncontrolled cell division.

**10** A number of physical and chemical factors can increase the chances of cancer. Agents which are known to have caused cancer are described as carcinogenic. Examples are asbestos (chemical) and ionising radiation (physical).

**11** Certain viruses, such as papilloma virus, can cause cancer. Genetic predisposition or inheritance of certain mutant genes may also contribute to the risk of cancer.

**Section revision ideas:** Review Vocab/Key Concepts handout, review EOCQs, review Book reading, draw out a cell throughout the stages of mitosis and the cell cycle,



**Biological molecules- Ch. 2**

***From small to large***

**1**The larger biological molecules are made from smaller molecules. Polysaccharides are made from monosaccharides, proteins from amino acids, nucleic acids from nucleotides, lipids from fatty acids and glycerol.

**2**Polysaccharides, proteins and nucleic acids are formed from repeating identical or similar subunits called monomers, and are therefore polymers. These build up into large molecules called macromolecules.

**3**The smaller units are joined together by condensation reactions. Condensation involves removal of water. The reverse process, adding water, is called hydrolysis and is used to break the large molecules back down into smaller molecules.

**4**The linkages that join monosaccharides are called glycosidic bonds. The linkages that join amino acids are called peptide bonds.

***Carbohydrates***

**5** Carbohydrates have the general formula Cx(H2O)y and comprise monosaccharides, disaccharides and polysaccharides.

**6**Monosaccharides (e.g. glucose) and disaccharides (e.g. sucrose) are very water-soluble and together are known as sugars.

**7**Monosaccharides are the smallest carbohydrate units. Glucose is the most common. They are important energy sources in cells and also important building blocks for larger molecules like polysaccharides.

**8**Monosaccharides may have straight-chain or ring structures and may exist in different isomeric forms such as α-glucose and β-glucose.

**9**Benedict’s reagent can be used to test for reducing and non-reducing sugars. The test is semi- quantitative.

**10**Polysaccharides include starch, glycogen and cellulose.

**11**Starch is an energy storage compound in plants. It is made up of two types of molecule, amylose and amylopectin, both made from α-glucose. Amylose is an unbranching molecule, whereas amylopectin has a branching structure. ‘Iodine solution’ can be used to test for starch.

**12**Glycogen is an energy storage compound in animals, which is also made from α-glucose. Its structure is similar to that of amylopectin, but with more branching.

**13**Cellulose is a polymer of β-glucose molecules. The molecules are grouped together by hydrogen bonding to form mechanically strong fibres with high tensile strength that are found in plant cell walls.

***Lipids***

**14**Lipids are a diverse group of chemicals, the most common of which are triglycerides (fats and oils).

**15**Triglycerides are made by condensation between three fatty acid molecules and glycerol. They are hydrophobic and do not mix with water. They are energy storage compounds in animals, as well as having other functions such as insulation and buoyancy in marine mammals.

**16**Phospholipids have a hydrophilic phosphate head and two hydrophobic fatty acid tails. This is important in the formation of membranes.

**17**The emulsion test can be used to test for lipids.

***Proteins***

**18**Proteins are long chains of amino acids which fold into precise shapes. The sequence of amino acids in a protein, known as its primary structure, determines the way that it folds and hence determines its three- dimensional shape and function.

**19**Many proteins contain areas where the amino acid chain is twisted into an α-helix; this is an example of secondary structure. The structure forms as a result of hydrogen bonding between the amino acids. Another secondary structure formed by hydrogen bonding is the β-pleated sheet.

**20** Further folding of proteins produces the tertiary structure. Often, a protein is made from more than one polypeptide chain. The association between the different chains is the quaternary structure of the protein. Tertiary and quaternary structures are very precise and are held in place by hydrogen bonds, disulfide bonds (which are covalent), ionic bonds and hydrophobic interactions.

**21** Proteins may be globular or fibrous. A molecule of a globular protein, for example haemoglobin, is roughly spherical. Most globular proteins are soluble and metabolically active. Haemoglobin contains a non- protein (prosthetic) group, the haem group, which contains iron. This combines with oxygen. A molecule of a fibrous protein, for example collagen, is less folded and forms long strands. Fibrous proteins are insoluble. They often have a structural role. Collagen has high tensile strength and is the most common animal protein, being found in a wide range of tissues.

**22** Biuret reagent can be used to test for proteins.

***Water***

**23** Water is important within plants and animals, where it forms a large part of the mass of each cell. It is also an environment in which organisms can live.

**24** As a result of extensive hydrogen bonding, water has unusual properties that are important for life: it is liquid at most temperatures on the Earth’s surface; its highest density occurs above its freezing point, so that ice floats and insulates water below from freezing air temperatures; it acts as a solvent for ions and polar molecules, and causes non-polar molecules to group together; it has a high surface tension, which affects the way it moves through narrow tubes and forms a surface on which some organisms can live. Water can also act as a reagent inside cells, as in hydrolysis reactions and in photosynthesis as a source of hydrogen.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Organic Molecule:** | **Elements** | **Made up of:** | **Function** | **Examples** |
| Carbohydrates | C, H, O | Monosaccharides | * Main source of energy for living things
* Structural support for plants
 | Glucose, Fructose, Glycogen, Starch, Cellulose |
| Lipids | C, H | Fatty acid & glycerol | * Store energy for living things
* Compose bi-layer in all cell membranes
* Leaves translucent spots on paper
* Steroids = chemical messengers
 | FatsOilsWaxes |
| Proteins | C, H, O, N | Amino Acids | * Regulate cell processes.
* Form bones & muscle.
* Transport substances in & out of cells.
* Fight off disease. (Immune System)
 | Enzymes, Hemoglobin, Collagen |
| Nucleic Acids | C, H, O, N, P | Nucleotides | * Stores genetic material
 | DNARNA |

Table adapted from: [http://www.gaston.k12.nc.us/](http://www.gaston.k12.nc.us/schools/cherryvillehigh/faculty/wrholt/Course%20Outline%20and%20Syllabus/GASTON%20COUNTY%20SCHOOLS%20biology%20EOC%20study%20guide%20revised.doc)

**Section revision ideas:** Review Vocab/Key Concepts handout, review EOCQs, review Book reading, review the table in your lab notebook for “Testing for Biological Molecules,” review the structures of the macromolecules

**Cell membranes and transport- Ch. 4**

**1**The basic structure of a membrane is a 7 nm thick phospholipid bilayer with protein molecules spanning the bilayer or within one or other layer. Phospholipids and some proteins move within the layers. Hence the structure is described as a fluid mosaic – the scattered protein molecules resemble pieces of a mosaic.

**2**Phospholipid bilayers are a barrier to most water- soluble substances because the interior of the membrane is hydrophobic.

**3**Cholesterol is needed for membrane fluidity and stability.

**4**Some proteins are transport proteins, transporting molecules or ions across the membrane. They may be either channel proteins or carrier proteins. Channel proteins have a fixed shape; carrier proteins change shape.

**5**Some proteins act as enzymes – for example, in the cell surface membranes of microvilli in the gut.

**6**Glycolipids and glycoproteins form receptors – for example, for hormones or neurotransmitters. They also form antigens, which are cell recognition markers.

**7**The cell surface membrane controls exchange between the cell and its environment.

**8**Some chemical reactions take place on membranes inside cell organelles, as in photosynthesis and respiration.

**9**Diffusion is the net movement of molecules or ions from a region of their higher concentration to one of lower concentration. Oxygen, carbon dioxide and water cross membranes by diffusion through the phospholipid bilayer.

**10** Diffusion of ions and larger polar molecules through membranes is allowed by transport proteins. This process is called facilitated diffusion.

**11** Water moves from regions of higher water potential to regions of lower water potential. When this takes place through a partially permeable membrane such as the cell surface membrane, this diffusion is called osmosis.

**12** Pure water has a water potential (ψ) of zero. Adding solute reduces the water potential by an amount known as the solute potential (ψs), which has a negative value. Adding pressure to a solution increases the water potential by an amount known as the pressure potential (ψp), which has a positive value. The following equation is used: ψ=ψs +ψp

**13** In dilute solutions, animal cells burst as water moves into the cytoplasm from the solution. In dilute solutions, a plant cell does not burst, because the cell wall provides resistance to prevent it expanding. The pressure that builds up is the pressure potential. A plant cell in this state is turgid. In concentrated solutions, animal cells shrink, while in plant cells the protoplast shrinks away from the cell wall in a process known as plasmolysis.

**14** Some ions and molecules move across membranes by active transport, against the concentration gradient. This needs a carrier protein and ATP to provide energy.

**15** Exocytosis and endocytosis involve the formation of vacuoles to move larger quantities of materials respectively out of, or into, cells by bulk transport. There are two types of endocytosis, namely phagocytosis (cell eating) and pinocytosis (cell drinking).

**Section revision ideas:** Review Vocab/Key Concepts handout, review EOCQs, review Fluid Mosaic Model

**CELL TRANSPORT:**

* ***Passive Transport*** – movement of substances across the plasma membrane without the use of the cell’s energy (with the concentration gradient)
1. DIFFUSION – movement of substances across the plasma membrane from an area of high concentration to an area of low concentration
2. OSMOSIS – diffusion of water across the plasma membrane from areas of high concentration to areas of lower concentration
3. FACILITATED TRANSPORT – a carrier molecule embedded in the plasma membrane transports a substance across the plasma membrane following the high-to-low concentration gradient
* ***Active Transport*** – movement of substances across the plasma membrane that requires the use of the cell’s energy and carrier molecules; substances are moving from an area of low concentration to an area of higher concentration (against the concentration gradient)
1. ENDOCYTOSIS – large particles are brought into the cell
2. EXOCYTOSIS – large particles leave the cell

**Enzymes- Ch. 3**

**1**Enzymes are globular proteins which catalyse metabolic reactions.

**2**Each enzyme has an active site with a specific shape, into which the substrate molecule or molecules fit precisely. This is the lock and key hypothesis – the substrate is compared with a key which fits precisely into the lock of the enzyme.

**3**The lock and key hypothesis has been modified. The modern hypothesis is called the induced fit hypothesis. The active site is no longer regarded as a rigid structure like a lock, but as a flexible structure which can change shape slightly to fit precisely the substrate molecule.

**4**When the substrate enters the active site, an enzyme–substrate complex is temporarily formed in which the R groups of the amino acids in the enzyme hold the substrate in place.

**5**Enzymes may be involved in reactions which break down molecules or join molecules together.

**6**Enzymes work by lowering the activation energy of the reactions they catalyse.

**7**The course of an enzyme reaction can be followed by measuring the rate at which a product is formed or the rate at which a substrate disappears. A progress curve, with time on the *x*-axis, can be plotted. The curve is steepest at the beginning of the reaction, when substrate concentration is at its highest. This rate is called the initial rate of reaction.

**8**Various factors affect the rate of activity of enzymes. Four important factors are enzyme concentration, substrate concentration, temperature and pH.

**9** The greater the concentration of the enzyme, the faster the rate of reaction, provided there are enough substrate molecules present. Similarly, the greater the concentration of the substrate, the faster the rate of reaction, provided enough enzyme molecules are present. During enzyme reactions, rates slow down as substrate molecules are used up.

**10** Each enzyme has an optimum temperature at which it works fastest. As temperature increases above the optimum temperature, the enzyme gradually denatures (loses its precise tertiary structure). When it is completely denatured, it ceases to function. Denaturation is sometimes reversible.

**11** Each enzyme has an optimum pH. Some enzymes operate within a narrow pH range; some have a broad pH range.

**12** Enzymes are also affected by the presence of inhibitors, which slow down their rate of reaction or stop it completely.

**13** Competitive inhibitors are molecules which are similar in shape to the normal substrate molecules. They compete for the active site of the enzyme. This type of inhibition is reversible because the inhibitor can enter and leave the active site.

**14** Non-competitive inhibitors either bind permanently to the active site or bind at a site elsewhere on the enzyme, causing a change in shape of the active site. Such binding may or may not be reversible.

**Section revision ideas:** Review Vocab/Key Concepts handout, review EOCQs, review Book reading, review the labs we did for enzymes, create a table of the factors affecting the rate of activity,

**Genetic control- Ch. 6**

**1**DNA and RNA are polynucleotides, made up of long chains of nucleotides.

**2**A nucleotide contains a pentose sugar, a phosphate group and a nitrogen-containing base. In RNA the sugar is ribose, and in DNA it is deoxyribose.

**3**A DNA molecule consists of two polynucleotide chains, linked by hydrogen bonds between bases. There are four bases – adenine always pairs with thymine, and cytosine with guanine. RNA, which comes in several different forms, has only one polynucleotide chain, although this may be twisted back on itself, as in tRNA. In RNA, the base thymine is replaced by uracil.

**4**DNA molecules replicate during interphase by semi-conservative replication. The hydrogen bonds between the bases break, allowing free nucleotides to fall into position opposite their complementary ones on each strand of the original DNA molecule. Adjacent nucleotides are then linked, through their phosphates and sugars, to form new strands. Two complete new molecules are thus formed from one old one, each new molecule containing one old strand and one new.

**5**The sequence of nucleotide bases on a DNA molecule codes for the sequence of amino acids in a polypeptide. Each amino acid is coded for by three bases. A length of DNA coding for just one polypeptide is a gene.

**6** A change in the nucleotide sequence of DNA is a mutation, producing a new allele of the gene.

**7** The DNA sequences for the HbA (normal) and HbS (sickle cell) alleles of the gene for the β-globin polypeptide differ by only one base. The triplet CTT in HbA is replaced by CAT in HbS, changing the amino acid glutamic acid to valine. This single difference in the polypeptide results in sickle cell anaemia in individuals with two HbS alleles.

**8** During protein synthesis, a complementary copy of the base sequence on a gene is made, by building a molecule of messenger RNA (mRNA) against one DNA strand. This stage is called transcription.

**9** After transcription, the next stage is called translation. In this stage the mRNA moves to a ribosome in the cytoplasm. Transfer RNA (tRNA) molecules with complementary triplets of bases temporarily pair with base triplets on the mRNA, bringing appropriate amino acids. As two amino acids are held side by side, a peptide bond forms between them. The ribosome moves along the mRNA molecule, so that appropriate amino acids are gradually linked together, following the sequence laid down by the base sequence on the mRNA.

|  |  |  |
| --- | --- | --- |
|  | **DNA** | **RNA** |
| Sugars | **Deoxyribose** | **Ribose** |
| Bases | **A, T, C, G** | **A, U, C, G** |
| Number of Strands | **2 strands** | **1 stand** |
| Where in the Cell | **Nucleus** | **Cytoplasm** |
| Function | **Stores genetic info** | **Transports genetic info** |

**Section revision ideas:** Review Vocab/Key Concepts handout, review EOCQs, review Book reading, review online interactives of concepts, draw a diagram of the stages of the Central Dogma, draw and label diagrams of both DNA and RNA,

Central Dogma:



**Transport in multicellular plants- Ch. 7 \*Note: this section will not be tested on in class**

**1**Multicellular organisms with small surface area to volume ratios need transport systems.

**2**Water and mineral salts are transported through a plant in xylem vessels. Movement of water is a passive process in which the water moves down a water potential gradient from soil to air.

**3**The energy for this process comes from the Sun, which causes evaporation of water from the wet walls of mesophyll cells in leaves. Water vapour in the air spaces of the leaf diffuses out of the leaf through stomata, in a process called transpiration. This loss of water sets up a water potential gradient throughout the plant.

**4**Transpiration is an inevitable consequence of gaseous exchange in plants. Plants need stomata so that carbon dioxide and oxygen can be exchanged with the environment.

**5**The rate of transpiration is affected by several environmental factors, particularly temperature, light intensity, wind speed and humidity. It is difficult to measure rate of transpiration directly, but water uptake can be measured using a potometer.

**6**Plants that are adapted to live in places where the environmental conditions are likely to cause high rates of transpiration, and where soil water is in short supply, are called xerophytes. They have often evolved adaptations that help to reduce the rate of loss of water vapour from their leaves.

**7** Water enters the plant through root hairs by osmosis. Water crosses the root either through the cytoplasm of cells (the symplast pathway) or via their cell walls (the apoplast pathway), and enters the dead, empty xylem vessels. It also moves across the leaf by symplast and apoplast pathways.

**8** Water moves up xylem vessels by mass flow, as a result of pressure differences caused by loss of water from leaves by transpiration. Root pressure can also contribute to this pressure difference.

**9** Mineral salts are essential nutrients. Examples are nitrate, which is needed for the synthesis of a wide variety of organic compounds, and magnesium, which is a constituent of chlorophyll.

**10** Translocation of organic solutes such as sucrose occurs through living phloem sieve tubes. The phloem sap moves by mass flow from a region known as the source to a region known as

the sink. Sucrose is produced at the source (e.g. photosynthesising leaves) and used at the sink (e.g. a flower or a storage organ).

**11** Mass flow occurs as a result of pressure differences between the source and the sink. Active loading of sucrose into the sieve tubes at the source results in the entry of water by osmosis, thus creating a high hydrostatic pressure in the sieve tubes.

**12** Both xylem vessels and phloem sieve tubes show unique structural features which are adaptations to their roles in transport.

**Section revision ideas:** Review the Surface Area/Volume ratio, including the Factsheets and reading on it

**The mammalian heart- Ch. 9**

**1**The human heart, like that of all mammals, has two atria and two ventricles. Blood enters the heart by the atria and leaves from the ventricles. A septum separates the right side of the heart, which contains deoxygenated blood, from the left side, which contains oxygenated blood.

**2**Semilunar valves at the entrances to the blood vessels that leave the heart (aorta and pulmonary artery) prevent backflow of blood into the heart, and atrioventricular valves prevent backflow of blood from ventricles into the atria.

**3**The heart is made of cardiac muscle and is myogenic (the muscle is self-stimulating).

**4** The sinoatrial node (SAN) sets the pace of contraction for the muscle in the heart. Excitation waves spread from the SAN across the atria, causing their walls to contract. A non-conducting barrier prevents these excitation waves from spreading directly into the ventricles, thus delaying their contraction. The excitation wave travels to the ventricles via the atrioventricular node (AVN) and the Purkyne tissue, which runs down through the septum, before spreading out into the walls of the ventricles.

**5** Both sides of the heart contract and relax at the same time. The contraction phase is called systole, and the relaxation phase is diastole. One complete cycle of contraction and relaxation is known as the cardiac cycle.

**The mammalian transport system- Ch. 8**

**1**Blood is carried away from the heart in arteries, passes through tissues in capillaries, and is returned to the heart in veins. Blood pressure drops gradually as it passes along this system.

**2**Arteries have thick, elastic walls, to allow them to withstand high blood pressures and to smooth out the pulsed blood flow. Capillaries are only just wide enough to allow the passage of red blood cells, and have very thin walls to allow efficient and rapid transfer of materials between blood and cells. Veins have thinner walls than arteries and possess valves to help blood at low pressure flow back to the heart.

**3**Blood plasma leaks from capillaries to form tissue fluid. This is collected into lymphatics as lymph, and returned to the blood in the subclavian veins. Tissue fluid and lymph are almost identical in composition; both of them contain fewer plasma protein molecules than blood plasma, as these are too large to pass through the pores in the capillary walls.

**4**Red blood cells are relatively small cells. They have a biconcave shape and no nucleus. Their cytoplasm is full of haemoglobin.

**5**White blood cells include phagocytes and lymphocytes. They all have nuclei, and are either spherical or irregular in shape.

**6** Red blood cells carry oxygen in combination with haemoglobin. Haemoglobin picks up oxygen at high partial pressures of oxygen in the lungs, and releases it at low partial pressures of oxygen in respiring tissues. A graph showing the percentage saturation of haemoglobin at different partial pressures (concentrations) of oxygen is known as a dissociation curve. At high carbon dioxide concentrations, the dissociation curve shifts downwards and to the right, showing that haemoglobin releases oxygen more easily when carbon dioxide concentration is high. This is known as the Bohr effect.

**7** Carbon dioxide is mostly carried as hydrogencarbonate ions in blood plasma, but also in combination with haemoglobin in red blood cells and dissolved as carbon dioxide molecules in blood plasma.

**8** At high altitudes, the partial pressure of oxygen is so low that altitude sickness can be caused, which can be fatal. The body can adapt to gradual changes, however, by producing more red blood cells and haemoglobin.

**Chapters not covered yet this year:**

**Gas exchange**

**1**  Multicellular organisms often have surfaces that are specialised to allow exchange of gases to take place between their bodies and the environment. Alveoli in the lungs form the gas exchange surface in mammals.

**2**  In the human lungs, air passes down the trachea and through a branching system of airways to reach the alveoli. The airways are lined by a ciliated epithelium with mucus-secreting goblet cells. The epithelium protects the alveoli by moving a carpet of mucus towards the throat, where it can be swallowed.

**3**  There are C-shaped rings of cartilage in the trachea and irregularly shaped blocks of cartilage in the bronchus to keep the large airways open and so reduce resistance to the flow of air. Smooth muscle in the airways contracts and relaxes to adjust the diameter of the airways.

**4** The alveoli are lined by a squamous epithelium that gives a short diffusion distance for the exchange of oxygen and carbon dioxide. The alveoli are well supplied with blood by the many capillaries surrounding the gas exchange surface.

**5** The constant flow of blood and the continuous ventilation of the lungs maintain concentration gradients between blood and air for oxygen and carbon dioxide.

**6** Recoil of the elastic fibres surrounding the alveoli helps to move air out during expiration.

**Smoking- Ch. 11**

**1**Tobacco smoke contains tar, carbon monoxide and nicotine.

**2**Tar settles on the epithelium lining the bronchi and bronchioles and stimulates inflammation, an increase in the secretion of mucus and an accumulation of phagocytes from the blood.

**3**Damage to the airways and alveoli occurs in chronic obstructive pulmonary disease (COPD). In chronic bronchitis, the airways are obstructed by mucus and infection; in emphysema, alveoli are destroyed, reducing the surface area for gas exchange.

**4**Tar contains carcinogens, which cause changes in DNA in bronchial epithelial cells, leading to the development of a bronchial carcinoma. This is lung cancer.

**5**Some of the signs and symptoms of COPD are breathlessness, wheezing and constant coughing; two of the symptoms of lung cancer are coughing up blood and chest pains.

**6**Carbon monoxide combines irreversibly with haemoglobin, reducing the oxygen-carrying capacity of the blood.

**7**Nicotine stimulates the nervous system, increasing heart rate and blood pressure, and stimulating vasoconstriction, which reduces blood flow to the extremities.

**8**Epidemiological evidence shows a strong correlation between smoking and lung diseases such as cancer; the link between smoking and lung cancer was confirmed by experimental studies.

**9** Smoking damages the cardiovascular system, increasing atherosclerosis and increasing the risk of coronary heart disease and stroke.

**10** Atherosclerosis is the development of fatty tissue within the walls of arteries. The fatty material, known as atheroma, forms plaques within the artery walls. These roughen the lining of arteries, which may lead to thrombosis (blood clotting).

**11** Coronary heart disease may be treated with drugs to lower blood cholesterol and blood pressure. Coronary artery by-pass surgery involves using a blood vessel from the leg, arm or chest to replace the part or parts of a coronary artery that are damaged. A heart transplant may be necessary, but it is an expensive operation and difficult to find donor hearts, so very few are performed.

**12** Primary health care can reduce mortality from coronary heart disease and strokes. Screening people for risk factors of coronary heart disease and stroke allows early intervention. Advertising and education can promote the benefits of exercise, not smoking, avoiding an excessive consumption of alcohol and eating a diet low in saturated fat. These alternatives to treatment and surgery may be more cost-effective in the long term, but they depend on people being willing and able to change their lifestyle.

**Ecology- Ch. 14**

**1**A habitat is a place where an organism lives. The niche of an organism is the role that it plays in the community.

**2**A population is a group of organisms of the same species, living in the same place at the same time, that can interbreed with one another. A community is all the organisms, of all the different species, living in the same place at the same time.

**3**An ecosystem is an interacting system of organisms and their environment, more or less self-contained.

**4**Energy flows from one organism to another in the form of chemical energy in organic molecules in food. The pathways of energy flow can be shown in a food chain or food web, in which the arrows show the direction of energy flow.

**5**The first organism in a food chain or food web is a producer. In most food chains, plants are the producers. They transfer energy from sunlight into chemical energy in organic molecules in the process of photosynthesis. All other organisms in a food chain are consumers.

**6**Each step in a food chain is a trophic level. Energy is lost as it passes from one trophic level to the next. The percentage of energy in one trophic level that passes to the next trophic level is generally around 10%. This value is the efficiency of energy transfer. It is generally relatively low for transfers from producers to primary consumers, because of the high content of cellulose in plants, which is not easily digested by most animals but contains a lot of energy.

**7** Nitrogen atoms are an essential part of many organic molecules, especially proteins and nucleic acids. Although a high percentage of the atmosphere is nitrogen gas, nitrogen molecules are very unreactive and cannot be used by most living organisms. The nitrogen must be fixed – converted into a more reactive form such as ammonium ions or nitrate

ions – before plants can make use of it. Lightning and nitrogen-fixing bacteria are the two most important natural methods of nitrogen fixation.

**8** Plants use ammonium ions or nitrate ions to make amino acids and then proteins. Consumers obtain amino acids from plants.

**9** Decomposers break down nitrogen-containing molecules in dead plants and animals, or in their waste products, such as urea. Ammonia is produced, which is converted to nitrite ions and then nitrate ions by nitrifying bacteria. Denitrifying bacteria convert nitrate ions back to nitrogen gas.

Links:

Genetic Control:

<http://www2.estrellamountain.edu/faculty/farabee/biobk/BioBookPROTSYn.html>

<http://biology.clc.uc.edu/courses/bio104/dna.htm>

Bio Molecules:

<http://www.biology.arizona.edu/biochemistry/tutorials/chemistry/page3.html>

Gas Transport and Exchange:

<http://www.fi.edu/learn/heart/blood/blood.html>

<http://www.fi.edu/learn/heart/index.html>

Cells:

<http://www.sparknotes.com/biology/cellreproduction/cellcycle/summary.html>

<http://www.sparknotes.com/biology/cellstructure/intro/>

<http://www.sparknotes.com/biology/cellstructure/celldifferences/>