Cells

Lessons TBAT	Key Knowledge	Practical	Assessment
TBAT: Describe methods of studying cells TBAT: Compare a light and electron microscope TBAT: Compare actual size, magnification and image size TBAT: Calibrate a graticule TBAT: Describe the structure and function of organelles TBAT: Describe the levels of organisation TBAT: Compare eukaryotic and prokaryotic cells	The structure of eukaryotic cells, restricted to the structure and function of: cell-surface membrane nucleus (containing chromosomes, consisting of protein-bound, linear DNA, and one or more nucleoli) mitochondria chloroplasts (in plants and algae) Golgi apparatus and Golgi vesicles lysosomes (a type of Golgi vesicle that releases lysozymes) ribosomes rough endoplasmic reticulum and smooth endoplasmic reticulum cell wall (in plants, algae and fungi) cell vacuole (in plants). In complex multicellular organisms, eukaryotic cells become specialised for specific functions. Specialised cells are organised into tissues, tissues into organs and organs into systems. **Students should be able to** apply their knowledge of these features in explaining adaptations of eukaryotic cells.	Students could use a microscope to identify differences between plant and animal cells Students could use iodine in potassium iodide solution to identify starch grains in plant cells **Required practical 2:** Preparation of stained squashes of cells from plant root tips; set-up and use of an optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index. Students should measure the apparent size of cells in the root tip and calculate their actual size using the formula **Required practical 3:** Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue.	End of unit test Maths focus Measuring the size of an object viewed with an optical microscope. The difference between magnification and resolution. Use of the formula: Image size = Actual size x magnification Calculation of a mitotic index Students could plot the data from their investigations in an appropriate format.

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TBAT: Describe the stages of mitosis TBAT: Explain the cell cycle TBAT: Describe the structure of the cell membrane	Prokaryotic cells are much smaller than eukaryotic cells. They also differ from eukaryotic cells in having: cytoplasm that lacks membrane-bound organelles smaller ribosomes no nucleus; instead they have a single circular DNA molecule that is free in the cytoplasm and is not associated with proteins a cell wall that contains murein, a glycoprotein. In addition, many prokaryotic cells have:	**Required practical 4:** Investigation into the effect of a named variable on the permeability of cell-surface membranes.	Students could determine the water potential of plant tissues using the intercept of a graph of, eg, water potential of solution against gain/loss of mass.

TBAT: Explain how molecules move by diffusion TBAT: Explain how molecules move by active transport TBAT: Explain how molecules move by facilitated diffusion TBAT: Explain how molecules move by osmosis TBAT: Describe the process of cotransport of glucose in the ileum. TBAT: Describe how the human body defends against infection	one or more plasmids a capsule surrounding the cell one or more flagella. Details of these structural differences are **not** required. Viruses are acellular and non-living. The structure of virus particles to include genetic material, capsid and attachment protein. The principles and limitations of optical microscopes, transmission electron microscopes and scanning electron microscopes. Measuring the size of an object viewed with an optical microscope. The difference between magnification and resolution. Use of the formula: Principles of cell fractionation and ultracentrifugation as used to separate cell components. **Students should be able to** appreciate that there was a considerable period of time during which the scientific community distinguished between artefacts and cell organelles. Within multicellular organisms, not all cells retain the ability to divide. Eukaryotic cells that do retain the ability to divide show a cell cycle.	Key stage 4 4.1 Cell biology Cells are the basic unit of all forms of life. In this section we explore how structural differences between types of cells enables them to perform specific functions within the organism. These differences in cells are controlled by genes in the nucleus. For an organism to grow, cells must divide by mitosis producing two new identical cells. If cells are isolated at an early stage of growth before they have become too specialised, they can retain their ability to grow into a range of different types of cells. This phenomenon has led to the development of stem cell technology. This is a new branch of medicine that allows doctors to repair damaged organs by growing new tissue from stem cells.

TBAT: Explain how phagocytosis happens TBAT: Describe the role of T lymphocytes in the immune response TBAT: Describe the role of B lymphocytes in the immune response TBAT: Link the structure and function of antibodies TBAT: Describe how a successful vaccination programme works TBAT: Describe the lifecycle of HIV	DNA replication occurs during the interphase of the cell cycle. Mitosis is the part of the cell cycle in which a eukaryotic cell divides to produce two daughter cells, each with the identical copies of DNA produced by the parent cell during DNA replication. The behaviour of chromosomes during interphase, prophase, metaphase, anaphase and telophase of mitosis. The role of spindle fibres attached to centromeres in the separation of chromatids. Division of the cytoplasm (cytokinesis) usually occurs, producing two new cells. **Students should be able to:** recognise the stages of the cell cycle: interphase, prophase, metaphase, anaphase and telophase (including cytokinesis) explain the appearance of cells in each stage of mitosis. Mitosis is a controlled process. Uncontrolled cell division can lead to the formation of tumours and of cancers. Many cancer treatments are directed at controlling the rate of cell division. Binary fission in prokaryotic cells involves: replication of the circular DNA and of plasmids division of the cytoplasm to produce two daughter cells, each with a single copy of the circular DNA and a variable number of copies of plasmids.	

	The basic structure of all cell membranes, including cell-surface membranes and the membranes around the cell organelles of eukaryotes, is the same. The arrangement and any movement of phospholipids, proteins, glycoproteins and glycolipids in the fluid-mosaic model of membrane structure. Cholesterol may also be present in cell membranes where it restricts the movement of other molecules making up the membrane. Movement across membranes occurs by: simple diffusion (involving limitations imposed by the nature of the phospholipid bilayer) facilitated diffusion (involving the roles of carrier proteins and channel proteins) osmosis (explained in terms of water potential) active transport (involving the role of carrier proteins and the importance of the hydrolysis of ATP) co-transport (illustrated by the absorption of sodium ions and glucose by cells lining the mammalian ileum). Cells may be adapted for rapid transport across their internal or external membranes by an increase in surface area of, or by an	

	increase in the number of protein channels and carrier molecules in, their membranes. **Students should be able to:** explain the adaptations of specialised cells in relation to the rate of transport across their internal and external membranes explain how surface area, number of channel or carrier proteins and differences in gradients of concentration or water potential affect the rate of movement across cell membranes Each type of cell has specific molecules on its surface that identify it. These molecules include proteins and enable the immune system to identify: pathogens cells from other organisms of the same species abnormal body cells toxins. Definition of antigen. The effect of antigen variability on disease and disease prevention. Phagocytosis of pathogens. The subsequent destruction of ingested pathogens by lysozymes.	

	The response of T lymphocytes to a foreign antigen (the cellular response). The role of antigen-presenting cells in the cellular response. The role of helper T cells (T_H cells) in stimulating cytotoxic T cells (T_C cells), B cells and phagocytes. The role of other T cells is **not** required The response of B lymphocytes to a foreign antigen, clonal selection and the release of monoclonal antibodies (the humoral response). Definition of antibody. Antibody structure. The formation of an antigen-antibody complex, leading to the destruction of the antigen, limited to agglutination and phagocytosis of bacterial cells. The roles of plasma cells and of memory cells in producing primary and secondary immune responses. The use of vaccines to provide protection for individuals and populations against disease. The concept of herd immunity. The differences between active and passive immunity	

	Structure of the human immunodeficiency virus (HIV) and its replication in helper T cells. How HIV causes the symptoms of AIDS. Why antibiotics are ineffective against viruses. The use of monoclonal antibodies in: targeting medication to specific cell types by attaching a therapeutic drug to an antibody medical diagnosis. Details of the commercial or scientific production of monoclonal antibodies are **not** required. Ethical issues associated with the use of vaccines and monoclonal antibodies. The use of antibodies in the ELISA test. **Students should be able to:** discuss ethical issues associated with the use of vaccines and monoclonal antibodies evaluate methodology, evidence and data relating to the use of vaccines and monoclonal antibodies	

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