Summary

Unit 1 - Cell Biology Current

3 of 6 weeks

Subject	Year	Start date	Duration
Biology	IB1	Week 1, May	6 weeks

Course Part

Curriculum

Aims

Appreciate scientific study and creativity within a global context through stimulating and challenging opportunities

Acquire a body of knowledge, methods and techniques that characterize science and technology

Apply and use a body of knowledge, methods and techniques that characterize science and technology

Develop an ability to analyse, evaluate and synthesize scientific information

Develop a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities

Develop experimental and investigative scientific skills including the use of current technologies

Develop and apply 21st century communication skills in the study of science

Become critically aware, as global citizens, of the ethical implications of using science and technology

Develop an appreciation of the possibilities and limitations of science and technology

Develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge

Objectives

Demonstrate knowledge and understanding of

- facts, concepts, and terminology
- methodologies and techniques
- communicating scientific information

Apply

- facts, concepts, and terminology
- methodologies and techniques
- methods of communicating scientific information

Syllabus Content

Core

1. Cell biology

1.1 Introduction to cells

Nature of science:

Looking for trends and discrepancies—although most organisms conform to cell theory, there are exceptions.

Ethical implications of research—research involving stem cells is growing in importance and raises ethical issues.

Understandings:

According to the cell theory, living organisms are composed of cells.

Organisms consisting of only one cell carry out all functions of life in that cell.

Surface area to volume ratio is important in the limitation of cell size.

Multicellular organisms have properties that emerge from the interaction of their cellular components.

Specialized tissues can develop by cell differentiation in multicellular organisms.

Differentiation involves the expression of some genes and not others in a cell's genome.

The capacity of stem cells to divide and differentiate along different pathways is necessary in embryonic development and also makes stem cells suitable for therapeutic uses.

Applications and skills:

Application: Questioning the cell theory using atypical examples, including striated muscle, giant algae and aseptate fungal hyphae.

Application: Investigation of functions of life in Paramecium and one named photosynthetic unicellular organism.

Application: Use of stem cells to treat Stargardt's disease and one other named condition.

Application: Ethics of the therapeutic use of stem cells from specially created embryos, from the umbilical cord blood of a new-born baby and from an adult's own tissues.

Skill: Use of a light microscope to investigate the structure of cells and tissues, with drawing of cells. Calculation of the magnification of drawings and the actual size of structures and ultrastructures shown in drawings or micrographs. (Practical 1)

1.2 Ultrastructure of cells

Nature of science:

Developments in scientific research follow improvements in apparatus—the invention of electron microscopes led to greater understanding of cell structure.

Understandings:

Prokaryotes have a simple cell structure without compartmentalization.

Eukaryotes have a compartmentalized cell structure.

Electron microscopes have a much higher resolution than light microscopes.

Applications and skills:

Application: Structure and function of organelles within exocrine gland cells of the pancreas and within palisade mesophyll cells of the leaf.

Application: Prokaryotes divide by binary fission.

Skill: Drawing of the ultrastructure of prokaryotic cells based on electron micrographs.

Skill: Drawing of the ultrastructure of eukaryotic cells based on electron micrographs.

Skill: Interpretation of electron micrographs to identify organelles and deduce the function of specialized cells.

1.3 Membrane structure

Nature of science:

Using models as representations of the real world—there are alternative models of membrane structure.

Falsification of theories with one theory being superseded by another—evidence falsified the Davson-Danielli model.

Understandings:

Phospholipids form bilayers in water due to the amphipathic properties of phospholipid molecules.

Membrane proteins are diverse in terms of structure, position in the membrane and function.

Cholesterol is a component of animal cell membranes.

Applications and skills:

Application: Cholesterol in mammalian membranes reduces membrane fluidity and permeability to some solutes.

Skill: Drawing of the fluid mosaic model.

Skill: Analysis of evidence from electron microscopy that led to the proposal of the Davson-Danielli model.

Skill: Analysis of the falsification of the Davson-Danielli model that led to the Singer-Nicolson model.

1.4 Membrane transport

Nature of science:

Experimental design—accurate quantitative measurement in osmosis experiments are essential.

Understandings:

Particles move across membranes by simple diffusion, facilitated diffusion, osmosis and active transport.

The fluidity of membranes allows materials to be taken into cells by endocytosis or released by exocytosis. Vesicles move materials within cells.

Applications and skills:

Application: Structure and function of sodium-potassium pumps for active transport and potassium channels for facilitated diffusion in axons.

Application: Tissues or organs to be used in medical procedures must be bathed in a solution with the same osmolarity as the cytoplasm to prevent osmosis.

Skill: Estimation of osmolarity in tissues by bathing samples in hypotonic and hypertonic solutions. (Practical 2)

1.5 The origin of cells

Nature of science:

Testing the general principles that underlie the natural world - the principle that cells only come from pre-existing cells needs to be verified.

Understandings:

Cells can only be formed by division of pre-existing cells.

The first cells must have arisen from non-living material.

The origin of eukaryotic cells can be explained by the endosymbiotic theory.

Applications and skills:

Application: Evidence from Pasteur's experiments that spontaneous generation of cells and organisms does not now occur on Earth.

1.6 Cell division

Nature of science:

Serendipity and scientific discoveries—the discovery of cyclins was accidental.

Understandings:

Mitosis is division of the nucleus into two genetically identical daughter nuclei.

Chromosomes condense by supercoiling during mitosis.

Cytokinesis occurs after mitosis and is different in plant and animal cells.

Interphase is a very active phase of the cell cycle with many processes occurring in the nucleus and cytoplasm.

Cyclins are involved in the control of the cell cycle.

Mutagens, oncogenes and metastasis are involved in the development of primary and secondary tumours.

Applications and skills:

Application: The correlation between smoking and incidence of cancers.

Skill: Identification of phases of mitosis in cells viewed with a microscope or in a micrograph.

Skill: Determination of a mitotic index from a micrograph.

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will

  ask students to formulate a reasoned argument to support their opinion or conclusion

  give students time to think through their answers before asking them for a response

  reward a new personal understanding, solution or approach to an issue

  ask open questions

  set students a task which required higher-order thinking skills (such as analysis or evaluation)

  build on a specific prior task

  help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)

  require students to take an unfamiliar viewpoint into account when formulating arguments

  ask questions that required the use of knowledge from a different subject from the one you are teaching

  include a reflection activity

  make a link to TOK

Social

- In this unit, we will

  have students work in small groups

  allocate, or ask students to allocate among themselves, different roles in a classroom discussion or activity

  have students peer assess their group performance or process

  support students in resolving a conflict in a team

  give a group assessment task

  give students feedback on how they worked as a group

  have students discuss their understanding of a text or idea among themselves and come up with a shared understanding

  provide an opportunity for students to analyse the impact of their behaviour on the class or on a group performance

  encourage students to consider alternative points of view or to take the perspective of others

  provide opportunities for students to make decisions

Developing IB Learners

Learner Profile

- Inquirers
- Knowledgeable
- Thinkers
- Risk-takers (Courageous)
- Reflective