Year 1, Unit 1 Cell Biology

Content Area: **Science**
Course(s): **IB Biology, HL**
Time Period: **First Marking Period**
Length: **4 Weeks**
Status: **Published**

Unit Overview

Students will learn the importance of cells as the main unit of life. Students will have an understanding of the microscopic properties that allow for the emergent properties of complex systems.

STAGE 1- DESIRED RESULTS

1.1 Looking for trends and discrepancies—although most organisms conform to cell theory, there are exceptions. (3.1)
Ethical implications of research—research involving stem cells is growing in importance and raises ethical issues.

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

1.3 Using models as representations of the real world—there are alternative models of membrane structure. (1.11)
Falsification of theories with one theory being superseded by another—evidence falsified the Davson-Danielli model.

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

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

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

Standards

2020 New Jersey Student Learning Standards- Science

Science and Engineering Practices

- Analyzing and Interpreting Data

- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions
- Developing and Using Models
- Obtaining, Evaluating, and Communicating Information
- Using Mathematics and Computational Thinking

Cross Cutting Concepts

- Influence of Engineering, Technology, and Science on Society and the Natural World
- Interdependence of Science, Engineering, and Technology
- Scale, Proportion, and Quantity
- Structure and Functions
- Systems and System Models

Disciplinary Core Ideas

Life Sciences

- LS1A: Structure and Functions
- LS1B: Growth and Development of Organisms

Essential Questions

1.1 How does the evolution of multicellular organisms allow cell specialization and cell replacement?

1.2 How do eukaryotes have a much more complex cell structure than prokaryotes?

1.3 How does the structure of biological membranes makes them fluid and dynamic?

1.4 How do the membranes control the composition of cells by active and passive transport?

1.5 How does the unbroken chain of life from the first cells on Earth to all cells in organisms alive today show patterns?

1.6 How is cell division essential but must be controlled?

Enduring Understanding

Students will have an appreciation and an understanding of the complexities of living systems and the components that allow them to function.

Students will know…

Topic 1.1

- 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.

Topic 1.2

- Prokaryotes have a simple cell structure without compartmentalization.
- Eukaryotes have a compartmentalized cell structure.
- Electron microscopes have a much higher resolution than light microscopes.

Topic 1.3

- 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.

Topic 1.4

- 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.

Topic 1.5

- 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.

Topic 1.6

- 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.

Students will be able to...

1.1

- Revise questioning the cell theory using atypical examples, including striated muscle, giant algae and aseptate fungal hyphae.
- Analyze investigation of functions of life in *Parameciu*mand one named photosynthetic unicellular organism.
- Explain use of stem cells to treat Stargardt's disease and one other named condition.
- Apply concepts of 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.

1.2

- Compare structure and function of organelles within exocrine gland cells of the pancreas and within palisade mesophyll cells of the leaf.
- Explain that prokaryotes divide by binary fission.

1.3

- Develop a logical argument around the idea that cholesterol in mammalian membranes reduces membrane fluidity and permeability to some solutes.

1.4

- Asses the structure and function of sodium–potassium pumps for active transport and potassium channels for facilitated diffusion in axons.
- Design an experiments to show that 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.

1.5

- Cite evidence from Pasteur's experiments that spontaneous generation of cells and organisms does not now occur on Earth.

1.6

- Critique the correlation between smoking and incidence of cancers.

STAGE 2- EVIDENCE OF LEARNING

Authentic Assessments

1.1

- 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.

1.2

- 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

- 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

- Skill: Estimation of osmolarity in tissues by bathing samples in hypotonic and hypertonic solutions.

1.6

- 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

Laboratories will be used for assessment

Quizzes will be given.

Benchmark Assessments

Chapter tests will be given.

STAGE 3- LEARNING PLAN

Instructional Map

Helpful guidance for implementing IB Biology Curriculum

1.1

- Students are expected to be able to name and briefly explain these functions of life: nutrition, metabolism, growth, response, excretion, homeostasis and reproduction.
- *Chlorella* or *Scenedesmus* are suitable photosynthetic unicells, but *Euglena* should be avoided as it can feed heterotrophically.
- Scale bars are useful as a way of indicating actual sizes in drawings and micrographs.

1.2

- Drawings of prokaryotic cells should show the cell wall, pili and flagella, and plasma membrane enclosing cytoplasm that contains 70S ribosomes and a nucleoid with naked DNA.
- Drawings of eukaryotic cells should show a plasma membrane enclosing cytoplasm that contains 80S ribosomes and a nucleus, mitochondria and other membrane-bound organelles are present in the cytoplasm. Some eukaryotic cells have a cell wall.

1.3

- Amphipathic phospholipids have hydrophilic and hydrophobic properties.
- Drawings of the fluid mosaic model of membrane structure can be two dimensional rather than three dimensional. Individual phospholipid molecules should be shown using the symbol of a circle with two parallel lines attached. A range of membrane proteins should be shown including glycoproteins.

1.4

- Osmosis experiments are a useful opportunity to stress the need for accurate mass and volume measurements in scientific experiments.

1.5

- Evidence for the endosymbiotic theory is expected. The origin of eukaryote cilia and flagella does not need to be included.
- Students should be aware that the 64 codons in the genetic code have the same meanings in nearly all organisms, but that there are some minor variations that are likely to have accrued since the common origin of life on Earth.

1.6

- The sequence of events in the four phases of mitosis should be known.
- Preparation of temporary mounts of root squashes is recommended but phases in mitosis can also be viewed using permanent slides.
- To avoid confusion in terminology, teachers are encouraged to refer to the two parts of a chromosome as sister chromatids, while they are attached to each other by a centromere in the early stages of mitosis. From anaphase onwards, when sister chromatids have separated to form individual structures, they should be referred to as chromosomes.

Modification/Differentiation of Instruction

Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity

- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

504 Plans

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep
- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork

- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

Modification Strategies

- Cooperative Grouping
- Oral Directions
- Peer Tutoring
- Preferential Seating
- Repeated Drill and Practice
- Use of Additional Reference Materials

Differentiation Strategies

High Preparation

- Alternative Assessments
- Group Investigations
- Independent Research / Project
- Multiple Intelligence Options
- Multiple Texts
- Varying Graphic Organizers

Horizontal Intergration- Interdisciplinary Connections

See Appendix

Vertical Integration- Discipline Mapping

Previous courses

6th grade – Diversity of life

7th grade – Populations and Ecosystems

8th grade – Environmental Issues

9th grade – Honors Biology

10th grade – Honors Chemistry

Possible next courses

Honors Physics

Anatomy & Physiology

IB Physics

Zoology

Forensics

Additional Materials

Videos used through McGraw Hill, Crash Course and Howard Hughes Medical Institute.

Current Research articles supplied through Newsela.