AP BIOLOGY

Cells

Essential Question

Defend the origin of eukaryotic cells.

What are the advantages and disadvantages of cellular compartmentalization?

How are living systems affected by the presence or absence of subcellular components?

Understandings

*Students will understand that:*

Cells are made of various subcomponents, each with a specific structure and function.

The structure determines the function of both the organelles individually and the cell as a whole. Cellular complexity determines organismal complexity.

Organisms started as prokaryotic simple cells and evolved to for eukaryotic cells.

Knowledge:

*Students will know:*

Organelles and subcellular structures, and the interactions among them, support cellular function.

Ribosomes comprise ribosomal RNA (rRNA) and protein. Ribosomes synthesize protein according to mRNA sequence.

Ribosomes are found in all forms of life, reflecting the common ancestry of all known life.

Endoplasmic reticulum (ER) occurs in two forms—smooth and rough. Rough ER is associated with membrane-bound ribosomes— Rough ER compartmentalizes the cell. Smooth ER functions include detoxification and lipid synthesis. Endoplasmic reticulum provides mechanical support, carries out protein synthesis on membrane-bound ribosomes, and plays a role in intracellular transport.

The Golgi complex is a membrane-bound structure that consists of a series of flattened membrane sacs. Functions of the Golgi include the correct folding and chemical modification of newly synthesized proteins and packaging for protein trafficking.

Mitochondria have a double membrane. The outer membrane is smooth, but the inner membrane is highly convoluted, forming folds. Mitochondrial double membrane provides compartments for different metabolic reactions.

Lysosomes are membrane-enclosed sacs that contain hydrolytic enzymes. Lysosomes contain hydrolytic enzymes, which are important in intracellular digestion, the recycling of a cell’s organic materials, and programmed cell death (apoptosis).

A vacuole is a membrane-bound sac that plays many and differing roles. In plants, a specialized large vacuole serves multiple functions. Vacuoles have many roles, including storage and release of macromolecules and cellular waste products. In plants, it aids in retention of water for turgor pressure.

Chloroplasts are specialized organelles that are found in photosynthetic algae and plants. Chloroplasts have a double outer membrane.

Membranes and membrane-bound organelles in eukaryotic cells compartmentalize intracellular metabolic processes and specific enzymatic reactions. Internal membranes facilitate cellular processes by minimizing competing interactions and by increasing surface areas where reactions can occur.

Membrane-bound organelles evolved from once free-living prokaryotic cells via endosymbiosis.

Prokaryotes generally lack internal membrane- bound organelles but have internal regions with specialized structures and functions.

Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.

Skills:

*Students will be able to:*

Use biological concepts to support explanations.

Make scientific claims and support those claims with biological concepts.

Predict the causes or effects of changes to cell structure or function based on biological concepts.

Curriculum Standards - 2019 College Board Course & Exam Description

Describe the structure and/ or function of subcellular components and organelles.

Explain how subcellular components and organelles contribute to the function of the cell.

Describe the role of the cell wall in maintaining cell structure and function.

Explain the effect of surface area-to-volume ratios on the exchange of materials between cells or organisms and the environment.

Explain how specialized structures and strategies are used for the efficient exchange of molecules to the environment.

Describe the membrane- bound structures of the eukaryotic cell.

Explain how internal membranes and membrane- bound organelles contribute to compartmentalization of eukaryotic cell functions.

Describe similarities and/or differences in compartmentalization between prokaryotic and eukaryotic cells.

Describe the relationship between the functions of endosymbiotic organelles and their free-living ancestral counterparts.

Mission Integration

(*Note: could be combined with performance task/design thinking culminating assessment)*

Care for the person – application of organelle structure/function via a case study about diseases that occur because of malfunctioning organelles.

Performance Task or Design Thinking Culminating Assessment

Performance task – Cell organelle “video dating” activity. Students will create a video about one cell part, personifying that organelle to teach other students about the structure/function of their organelle.

Other Evidence (formative assessments, summative assessments)

*what homework and other out of class experiences are needed to equip students?*

Cell parts “headbandz” game

Case Study – Leigh’s Syndrome

Mastering Biology

AP Multiple Choice & FRQ end of unit assessment

Topic Overview

*Order of topics presented (Calendar)*

Cell organelles

Eukaryote vs. Prokaryote & Endosymbiotic Theory

Learning Plan

*Learning Activities - What experiential or inductive learning will help students to explore the big ideas and questions to achieve desired understandings? for their expected performances?*

Headbandz to review cell parts

Cell “Video Dating”

Case study – Leigh’s syndrome

Resources

Biology in Focus 2nd edition

MasteringBiology

Video Dating – assignment directions, Google Slides template for students to complete. Students need video recording app.

Cell parts Headbandz cards

Case study on Leigh Syndrome from National Center for Case Study Teaching in Science