Unit 05: Cellular Reproduction

Content Area: **Science**
Course(s):
Time Period: **Marking Period 3**
Length: **5-6 Weeks**
Status: **Published**

Summary

Introduction:

The focus of this unit is on asexual and sexual reproduction at the cellular level. Students will learn the processes and the importance of cellular reproduction in order to apply this content knowledge to real-world phenomena. The processes of mitosis and meiosis will be compared and contrasted, with an emphasis on the importance of genetic diversity. Microscopes will be used to observe cells at various stages in the cell cycle and quantify the number of time cells spend in each phase. Students will discuss the role of stem cells in the body and how cancer results from errors in the cell cycle.

Revised June 2022

Standards

MA.S-ID	Interpreting Categorical and Quantitative Data
PFL.9.1.12.CFR	Civic Financial Responsibility
MA.S-ID.A	Summarize, represent, and interpret data on a single count or measurement variable
LA.RL.9-10.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
MA.S-ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
	Constructing explanations and designing solutions in 9–12 builds on K–8 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

LA.W.9-10.1.A	Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.
MA.A-REI.A	Understand solving equations as a process of reasoning and explain the reasoning
MA.A-REI.B	Solve equations and inequalities in one variable
LA.W.9-10.2.E	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
LA.W.9-10.2.F	Provide a concluding paragraph or section that supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
MA.A-REI.D	Represent and solve equations and inequalities graphically
	Comprehension and Collaboration
LA.SL.9-10.2	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.
LA.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
LA.L.9-10	Language
	Obtaining, Evaluating, and Communicating Information
SCI.HS-LS1	From Molecules to Organisms: Structures and Processes
SCI.HS.LS1.A	Structure and Function
	Structure and Function
	Planning and Carrying Out Investigations
SCI.HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
SCI.HS.LS1.B	Growth and Development of Organisms
SCI.HS.LS3.B	Variation of Traits
SCI.HS.LS4.A	Evidence of Common Ancestry and Diversity
WRK.9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
TECH.9.4.2.CI.1	Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2).
TECH.9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
TECH.9.4.2.CT	Critical Thinking and Problem-solving
TECH.9.4.2.CT.2	Identify possible approaches and resources to execute a plan (e.g., 1.2.2.CR1b, 8.2.2.ED.3).
TECH.9.4.2.CT.3	Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
TECH.9.4.2.DC.6	Identify respectful and responsible ways to communicate in digital environments.
TECH.9.4.2.TL.2	Create a document using a word processing application.
TECH.9.4.2.TL.3	Enter information into a spreadsheet and sort the information.
TECH.9.4.2.GCA	Global and Cultural Awareness
TECH.9.4.2.GCA.1	Articulate the role of culture in everyday life by describing one’s own culture and comparing it to the cultures of other individuals (e.g., 1.5.2.C2a, 7.1.NL.IPERS.5, 7.1.NL.IPERS.6).
TECH.9.4.2.IML	Information and Media Literacy

TECH.9.4.2.IML.1	Identify a simple search term to find information in a search engine or digital resource.
TECH.9.4.2.IML.2	Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
TECH.9.4.2.IML.3	Use a variety of sources including multimedia sources to find information about topics such as climate change, with guidance and support from adults (e.g., 6.3.2.GeoGI.2, 6.1.2.HistorySE.3, W.2.6, 1-LSI-2).
	Critical thinkers must first identify a problem then develop a plan to address it to effectively solve the problem.
	Individuals should practice safe behaviors when using the Internet.
	Brainstorming can create new, innovative ideas.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
	Individuals from different cultures may have different points of view and experiences.
	Digital tools can be used to display data in various ways.
	Information is shared or conveyed in a variety of formats and sources.
	Collaboration can simplify the work an individual has to do and sometimes produce a better product.
	Digital communities allow for social interactions that can result in positive or negative outcomes.

Essential Questions/ Enduring Understanding

Essential Questions:

How do the processes of sexual reproduction differ from asexual reproduction in creating either genetically identical or genetically varied organisms?

What are the mechanisms by which cells regulate the cell cycle and how is cell cycle regulation related to cancer?

How can stem cells become differentiated and how does this enable stem cells to be used in medical research?

How are karyotypes used to identify chromosomal abnormalities and what are the resulting effects of mutations on chromosome structure and function?

Enduring Understandings:

Asexual and sexual reproduction differ in processes and products for the growth, repair, and reproduction of living organisms.

The cell cycle is carefully regulated by a series of biological processes.

Cells become specialized for different functions in organisms.

Cancer results when cells bypass cellular regulation mechanisms.

Objectives

Students will know Key Vocabulary: cell division, asexual reproduction, sexual reproduction, cell cycle, mitosis, interphase, prophase, metaphase, anaphase, telophase, parent cell, daughter cell, chromosome, duplicated chromosome, chromatin, sister chromatid, spindle, centriole, centromere, cytokinesis, apoptosis, cancer, differentiation, specialization, stem cell, gene, homologous chromosome, somatic (body) cell, gamete (sex cell), fertilization, meiosis, crossing over, genetic variation.

Students will know the importance of cellular division for living organisms.

Students will know how the process of cellular division utilized by prokaryotic cells relates to the structure of prokaryotic cells.

Students will know the mechanisms of each stage of mitosis and meiosis.

Students will know how the structures of eukaryotic cells assist in cellular division.

Students will know how the process of apoptosis is important to the health of the organism.

Students will know the mechanisms of each stage of the eukaryotic cell cycle (mitosis and meiosis).

Students will know the processes that regulate the cell cycle in eukaryotic cells.

Students will know how the regulation of the cell cycle between cancer cells and other cells.

Students will know how cancer can be caused, diagnosed, and treated.

Students will know how stem cells become differentiated and how they can be used in medical research.

Students will know the similarities and differences between mitosis and meiosis.

Students will know how karyotypes can be used to identify abnormalities in chromosome structure.

Students will be skilled at differentiating between asexual and sexual reproduction.

Students will be skilled at describing how cellular structures function in a cellular division in prokaryotes and eukaryotes.

Students will be skilled at calculating the number of time cells spend in each phase of the cell cycle by identifying the phases of mitosis in plant and animal cells under a compound light microscope.

Students will be skilled at explaining how abnormal cell cycles can result in cancer and the potential for tumor growth.

Students will be skilled at differentiating between how adult stem cells and embryonic stem cells become specialized.

Students will be skilled at evaluating controversies and ethical issues surrounding stem cells and stem cell research.

Students will be skilled at evaluating the processes of mitosis and meiosis for similarities and differences.

Students will be skilled at connecting the mechanisms of meiosis to genetic variation in organisms.

Students will be skilled at differentiating between gamete formation in males and females.

Students will be skilled at identifying chromosomal abnormalities from human karyotypes.

Learning Plan

Unit Notes: Students will record detailed notes in a notebook that cover the learning goals of the unit.

Onion Root Tip Cell Cycle Lab: Students will generate a hypothesis which phase of the cell cycle cells spend the most time in. To test this hypothesis, students will observe and identify cells in each phase of the cell cycle using prepared microscope slides of cells found in onion root tips. They will count the number of cells in each phase of the cell cycle and use this number to calculate the percentage of cells found in each stage to determine which stage is the longest and most important. Students will also draw a cell in each phase of the cell cycle and label the cellular structures they identify. This lab can be used as a formal lab report.

Mitosis vs. Meiosis Venn Diagram: Students will use their understanding of cellular division to compare and contrast mitosis and meiosis (asexual and sexual reproduction) by creating a Venn Diagram.

Modeling Meiosis Lab: Students will use pipe cleaners or clay to model each stage of meiosis. Students will take pictures of the model of each phase and describe what is occurring in the cell during each phase. Students will also answer lab analysis questions about how each stage of meiosis results in genetic variation in the resulting daughter cells.

Karyotype Pamphlet: Students will first practice creating a karyotype using an online simulation. Then, students will be randomly assigned to a case study, for which they will create a karyotype to diagnose a patient with a specific genetic disorder. Students will then research the symptoms, diagnosis, and treatment of the disorder to create an informative pamphlet about the genetic disorder.

Cancer Research Assignment: Students will be assigned one form of cancer to research and create an informational presentation about. Students will research the symptoms, diagnosis, and treatment of cancer and use this information to create a presentation. Students will also connect the form of cancer to its effects on the cell cycle. Students will present information to the class.

Cancer Webquest: Students will conduct online web research to learn about how cancer is related to the cell cycle. Students will visit provided online web addresses to research and answer questions about how the cell cycle is regulated in normal cells and how cancer cells bypass certain features of cell cycle regulation.

Stem Cell Webquest: Students will conduct online web research to learn about adult and embryonic stem cells. They will visit provided online web addresses to research and answer questions about the history, importance, pros/cons, and ethical issues surrounding it, as well as argue for/against it using research evidence and appropriate reasoning.

Assessment

Formative:

Do Now Questions

Exit Ticket Questions

Whole Class Discussion Participation

Small Group Discussion Participation

Think-Pair-Share Participation

Individual Student Questions/Responses

Independent Tasks (Cancer WebQuest, Stem Cell WebQuest, Mitosis vs. Meiosis Venn Diagram)

Lab Experiments (The Onion Root Tip Cell Cycle, Modeling Meiosis)

Quizzes (Mitosis, Meiosis)

Projects (Karyotype Pamphlet, Cancer Research Presentation)

Summative:

Formal Lab Report (The Onion Root Tip Cell Cycle)

Unit Test

Benchmark:

Honors Biology Final Exam

Alternative Assessments:

Unit Study Guide/Guided Test

Cancer Research Presentation

Current Event Paper

Materials

Textbook: Biology Concepts and Connections (Pearson Education) by Campell, Reece, Taylor, Simon, Dickey (2009)

Unit Learning Outline

Technology: computers for students and teachers, SmartBoard projector

Teacher Slide Presentations

Whiteboard + Accessories

Guided Notes/Worksheets

Lab Report Outline and Rubric

Personal Protective Equipment: safety glasses, gloves

Lab Equipment: beakers, water, microscopes, microscope slides, onion, chemical solutions, pipe cleaners

Graphing paper, rulers, colored pencils/markers