HOLLISTON Public Schools

Unit 2: Mitosis and Meiosis

Subject Area: Science and Technology	**Course**: Genetics		
Unit Title: Mitosis and Meiosis	**Grade(s)**: 10-12	**Start**: September	**End**: September
Unit Summary: This unit of the course focuses on different forms of cell division in multicellular organisms. The unit begins with a review of eukaryotic cell structure with a heavy focus on the structure and function of the cell's nucleus. Students will review DNA and learn how it is contained within the nucleus in the form of chromatin. From here, students will learn about cell cycling that results in mitosis and the purposes of this process. Students will then learn about meiosis which is necessary to produce sex cells (gametes) in sexually reproducing organisms. Finally, students will focus on human meiosis and the similarities and differences between spermatogenesis and oogenesis.			

Stage 1: Desired Results

Massachusetts Learning Standards

- HS-LS1-1. Construct a model of transcription and translation to explain the roles of DNA and RNA that code for proteins that regulate and carry out essential functions of life.
- HS-LS1-4. Construct an explanation using evidence for why the cell cycle is necessary for the growth, maintenance, and repair of multicellular organisms. Model the major events of the cell cycle, including (a) cell growth and DNA replication, (b) separation of chromosomes (mitosis), and (c) separation of cell contents.
- HS-LS1-6. Construct an explanation based on evidence that organic molecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form monomers that can further combine to form large carbon-based macromolecules.
- HS-LS3-1. Develop and use a model to show how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction.
- HS-LS3-2. Make and defend a claim based on evidence that genetic variations (alleles) may result from (a) new genetic combinations via the processes of crossing over and random segregation of chromosomes during

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meiosis, (b) mutations that occur during replication, and/or (c) mutations caused by environmental factors. Recognize that mutations that occur in gametes can be passed to offspring.
- HS-LS3-3. Apply concepts of probability to represent possible genotype and phenotype combinations in offspring caused by different types of Mendelian inheritance patterns.
- HS-LS3-4(MA). Use scientific information to illustrate that many traits of individuals, and the presence of specific alleles in a population, are due to interactions of genetic factors and environmental factors.

Vision of a Graduate Performance Outcome(s)

Global Citizen

A global citizen is someone who:

- Demonstrates an awareness of themselves and empathizes with and respects others' languages, customs, beliefs, and values.
- Takes actions to participate at local to global levels to advocate for and make changes towards social equity and sustainability.

Innovative Thinker

An innovative thinker is someone who:

- Uses reasoning to question, process, and evaluate Information.
- Is curious, creative, resourceful, and adaptable when looking for solutions.
- Approaches challenges as opportunities for growth.

Balanced Life

An individual with a balanced life is someone who:

- Identifies and maintains the characteristics of relationships that support overall personal health and wellness.
- Demonstrates skills for self-awareness, self-regulation, and self-advocacy.

- Applies strategies to prioritize, manage time, and organize responsibilities, and adjusts routines accordingly to support health and happiness.
- Identifies and maintains interests and/or passions that foster overall health and happiness.

Lifelong Learner

A lifelong learner is someone who:

- Explores a variety of learning opportunities and experiences to inform life decisions.
- Takes ownership of their learning by adapting to change, responding to feedback, and demonstrating persistence.
- Finds the curiosity and motivation within themselves to identify opportunities for personal growth and self-improvement.

Effective Communicator

An effective communicator is someone who:

- Selects, uses, and interprets types of communication (verbal, non-verbal, digital) according to context and audience.
- Collaborates with others in order to achieve desired learning outcomes.
- Engages others with differing opinions through thoughtful, healthy discourse.
- Presents information in a purposeful manner to a variety of audiences in order to inform, influence, motivate, and/or entertain.

Transfer (Authentic, relevant application of learning to new situations)

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Students will be able to independently use their learning to…

- Devise a hypothetical multicellular organism and identify its diploid chromosome number:
  - Draw and explain the process(es) needed for this organism to grow and repair its tissues.
  - Draw and explain the process(es) needed for this organism to be able to sexually reproduce.

Meaning

Enduring Understandings

Students will understand that…

- Eukaryotic cell structure is significantly more complex than prokaryotic cell structure. The presence of a nucleus allows a cell to better protect its DNA and carry out functions within the cell.
- The purpose of mitosis is to produce two diploid daughter cells that are genetically identical to each other and the parent cell from which they originated from. This process is done in multicellular organisms for the purpose of growth or tissue repair.
- Meiosis is a process of cell division that results in four haploid daughter cells that are genetically different from one another. The resulting cells are gametes (sex cells) that allow the organisms to sexually reproduce.
- Spermatogenesis is a form of meiosis that takes place in male reproductive systems. The process always results in four haploid sperm cells. Oogenesis is a form of meiosis that takes place in female reproductive systems. It results in one functioning egg cell which takes in most of the

Essential Questions

Students will consider…

- How is eukaryotic cell structure different from prokaryotic cell structure?
- What is the function of mitosis in multicellular organisms?
- What is the function of meiosis in multicellular organisms?
- How does spermatogenesis differ from oogenesis?

cytoplasm. The remaining cells are called polar bodies and are discarded.	
Acquisition	
Skills **Students will be skilled at…** ● Conducting inquiry based experimentation with problem solving in groups ● Using scientific tools such as a microscope ● Interpreting graphs and data to make conclusions ● Creating and interpreting punnett squares ● Creating and interpreting a pedigree charts ● Solving probability problems	**Knowledge** **Students will know…** ● Prokaryotic vs. Eukaryotic cell structure ● Cell nucleus structure and function ● Chromatin vs. Chromosomes ● Chromosomes consist of homologous pairs ● Alleles are versions of a gene that are present within a homologous chromosome pair ● Outcome of mitosis (purpose) ● Cell cycling (for growth and repair): ○ G1 phase ○ S phase ○ G2 phase ○ Mitosis (PMAT) ○ Cytokinesis ● Kinases ● Cyclins and their function ● Diploid cells ● Haploid cells ● Outcome of meiosis (purpose) ● Meiosis I ● Meiosis II ● Crossing over

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	• Nondisjunction • Human Organism: spermatogenesis vs. oogenesis - similarities and differences • Alternation of generations within certain species