MYP/3D Science Unit Planner
Marietta City Schools

Grade & Course: 9th/10th Grade Biology	**Topic: Molecular Genetics:** The Central Dogma of Biology	**Duration:** 3.5 weeks
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Georgia Standards of Excellence:

SB2. Obtain, evaluate, and communicate information to analyze how genetic information is expressed in cells.

SB2a. Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.

SB2b. Construct an argument based on evidence to support the claim that inheritable genetic variations may result from: ~~new genetic combinations through meiosis (crossing over, nondisjunction)~~; non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or heritable mutations caused by environmental factors (radiation, chemicals, and viruses).

SB2c. Ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture. (Clarification statement: The element is intended to include advancements in technology relating to economics and society such as advancements may include Genetically Modified Organisms.)

Narrative / Background Information

Prior Student Knowledge: (REFLECTION – PRIOR TO TEACHING THE UNIT)

S7L3. Obtain, evaluate, and communicate information to explain how organisms reproduce either sexually or asexually and transfer genetic information to determine the traits of their offspring.

a. Construct an explanation supported with scientific evidence of the role of genes and chromosomes in the process of inheriting a specific trait.

b. Develop and use a model to describe how asexual reproduction can result in offspring with identical genetic information while sexual reproduction results in genetic variation. (Clarification statement: Models could include, but are not limited to, the use of monohybrid Punnett squares to demonstrate the heritability of genes and the resulting genetic variation, identification of heterozygous and homozygous, and comparison of genotype vs. phenotype.)

c. Ask questions to gather and synthesize information about the ways humans influence the inheritance of desired traits in organisms through selective breeding. (Clarification statement: The element specifically addresses artificial selection and the ways in which it is fundamentally different from natural selection.)

Year-Long Anchoring Phenomena: (LEARNING PROCESS)

Sickle cell is a heritable genetic mutation that evolved in response to interactions in ecosystems**.**

Unit Phenomena (LEARNING PROCESS)

Malaria and sickle cell anemia - sickle cell disease is a genetic mutation that may be reversed by gene therapy.

MYP Inquiry Statement:

Societies must consider the consequences of change made possible by the biological revolution's technological innovations.

Approaches to Learning Skills: *	**Disciplinary Core Ideas: (KNOWLEDGE & SKILLS)**	**Crosscutting Concepts: *** (KNOWLEDGE & SKILLS)**
Communication Skills Collaboration Skills Research Skills	• DNA Structure & Function • DNA Replication • DNA Mutations (insertions, deletions, substitutions) • Heritable mutations (caused by environmental factors) • Protein Synthesis (transcription and translation) • Advancements in biotechnology and their impact on economics and society (i.e. GMOs). • Ethical, societal, and economical considerations of biotechnology and genetic engineering.	Cause & Effect Structure and Function System and system models **MYP Key and Related Concepts: **** Key Concept - Cause & Effect Related Concepts Structure and Function System and system models Sciences - Form and Models

GADOE Achievement Level Descriptors for Biology
GADOE Inspire Notes for Biology

Disciplinary Core Content: molecular genetics
Focus Science & Engineering Practices: developing and using models; constructing explanations
Focus Crosscutting Concepts: structure and function

SB2a: Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.
SB2b: Construct an argument based on evidence to support the claim that inheritable genetic variations may result from: non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or heritable mutations caused by environmental factors (radiation, chemicals, and viruses).
SB2c: Ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture. *(Clarification statement: The element is intended to include advancements in technology relating to economics and society such as advancements may include Genetically Modified Organisms.)*

Refer to the Georgia Standards of Excellence outlined on page 1 of the unit planner.

Beginning *Students performing in the beginning range are able to consistently…*	**Developing** *Students performing in the developing range are able to consistently…*	**Proficient** *Students performing in the proficient range are able to consistently…*	**Distinguished** *Students performing at the distinguished range are able to consistently…*
As a ***beginning learner***, I can… • recognize the role of cellular reproduction in maintaining genetic continuity; • identify features in the structures of DNA; • identify considerations related to the use of biotechnology in forensics, medicine, and	As a ***developing learner***, I can… • recognize models used to explain the role of cellular reproduction in maintaining genetic continuity; • recognize that the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication,	As a ***proficient learner***, I can… • develop and use models to explain the role of cellular reproduction (i.e., binary fission and mitosis) in maintaining genetic continuity; • construct an explanation of how the structures of DNA and RNA lead to the expression of information within	As a ***distinguished learner***, I can… • refine models to explain the role of cellular reproduction in maintaining genetic continuity; • refine an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation;

agriculture	transcription, and translation; • gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture;	the cell via the processes of replication, transcription, and translation • ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture;	• refine questions used to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture;

The intent of standard SB1b is for students to develop and use models to investigate mitosis and the purpose of cell division in cellular growth and repair. The *details* of the sub processes of the cell cycle and mitosis are beyond the scope of the HS Biology course. Calculations for SA to V ratio (if used to illustrate a need for cellular division) should be limited to square cell models to meet the intent of the HS Biology standard.
For standard SB2a, historical scientific discoveries related to DNA and the scientists responsible are outside the scope of the course. The details of the specific enzymes involved in replication, transcription, and translation are beyond the scope of the HS Biology course. The detailed processes of transcription and translation in protein synthesis is limited to a conceptual understanding.

Student Friendly Learning Targets

1. I can describe the general structure of DNA: double helix, base pairs, sugar/phosphate backbone, nitrogenous bases, hydrogen bonds, twisted.
2. I can state the base pairing rules for DNA (Chargaff's Rule).
3. I can explain the basic steps involved in DNA replication (exact copy, uses multiple enzymes, strands unwind and unzip, bonds break between base pairs, each half used a template for new identical strand, attachment of free nucleotides).
4. I can state why DNA replication is referred to as "semi-conservative".
5. I can communicate that genetic information, expressed by the transcription and translation of a gene, results in a protein.
6. I can define a chromosome as a long DNA molecule consisting of hundreds of genes that code for proteins.
7. I can explain how the structure of DNA allows it to store genetic information, direct the production of proteins, and pass the data to new cells (base pairing, order of nucleotides, weak bonding between bases, supercoiled when not replicating, relaxed when replicating).
8. I can communicate that the central dogma of genetics explains the conversion of DNA (cellular instructions) into a functioning product (protein), and that genetic information flows from the genetic code of DNA, to RNA, to functional proteins expressed as traits.
9. I can explain that DNA carries information to produce proteins in a triplet code (codon), and that each sequence of three nucleotides either codes for a particular amino acid or the sequence's beginning or end.
10. I can support the claim that the unique arrangement of nucleotides on a gene leads to differences in organisms.
11. I can explain why DNA does not leave the nucleus, but RNA can.
12. I can describe the differences between the structure and function of DNA compared to RNA.
13. I can state the function of mRNA, rRNA, and tRNA in protein synthesis.
14. I can explain the basic steps of how transcription transcribes the genetic code of DNA into a segment of RNA.
15. I can explain the basic steps of explaining how translation converts the information of MRNA into a sequence of amino acids to make a protein.
16. I can transcribe and translate a gene into an amino acid sequence.
17. I can explain that there is redundancy in the codon table (that there are multiple codons that code for each amino acid).
18. I can explain how a change in the nucleotide sequence of a DNA molecule can become a genetic mutation.
19. I can explain that exposure to agents such as ultraviolet light, radiation, substances in tobacco products, and other chemical compounds can cause mutations.
20. I can explain that spontaneous mutations during DNA replication can cause mutations.
21. I can state the difference between a gene mutation and a chromosomal mutation.
22. I can describe substitution mutations, insertion mutations, and deletion mutations, and explain how the outcome of the mutation depends on the changes it causes to the protein created.

23. I can provide evidence to support the claim that not all mutations are bad, and that some produce advantageous new phenotypes.
24. I can define the term biotechnology, and state simple examples of how it is used in forensics, medicine, and agriculture.
25. I can define the term genetic engineering, and state simple examples of how it is used in agriculture.
26. I can provide a basic definition of each of the following techniques used to manipulate DNA: restriction enzymes, PCR, gel electrophoresis, DNA fingerprinting, bacterial plasmids, and cloning.
27. I can ask my own questions to gather information about the ethical use of biotechnology and genetic engineering in forensics, medicine and agriculture, including societal, economical, and environmental benefits and risks.

Possible Preconceptions/Misconceptions: (REFLECTION – PRIOR TO TEACHING THE UNIT)

All organisms have the same number of chromosomes; DNA is different than chromosomes; mutations in somatic cells are passed along to future generations; mutations are not random; all mutations are negative; nucleus is the "brain" of the cell, but students don't have a true understanding of why; proteins are just the nutrients found in meats- not aware of the true function and variety of proteins found in organisms; structure of proteins are the same; cancer is caused by environmental factors only; all mutations are harmful; DNA can leave the nucleus; GMOs have negative effects on our health

Key Vocabulary: (KNOWLEDGE & SKILLS)

- Amino Acid
- Artificial Selection
- Base Pair Rule
- Biotechnology
- Carcinogen
- Central Dogma
- Codon
- Chromosomal Mutation
- Chromosome
- Clone
- Crossing Over
- Deletion Mutation
- DNA
- DNA Fingerprinting
- Double Helix
- Ethics
- Gamete
- Gel Electrophoresis
- Gene Mutation
- Gene Therapy
- Genetic Engineering
- Genetic Variation
- Genetically Modified Organism
- Homologous Chromosomes
- Insertion Mutation
- Inversion Mutation
- Karyotype
- Meiosis
- Mitosis
- mRNA
- Mutagen
- Nitrogenous Base
- Nondisjunction
- Point Mutation
- Polypeptide
- Protein
- Protein Synthesis
- RNA
- rRNA
- Recombinant DNA
- Replication
- Ribosome
- Selective Breeding
- Transcription
- Transgenic Organism
- Translation
- Trisomy
- tRNA

Inquiry Questions:

Factual:

What is DNA?
What are the roles of organelles involved in protein synthesis?
What are the phases of mitosis and what are their functions?
Which types of cells undergo mitosis?
What are the three parts of a nucleotide?
What are the similarities and differences between DNA and RNA?
What is the central dogma of biology?
What are the functions of the processes of transcription and translation?
Which molecules are involved in both transcription and translation?
Where do the processes of transcription and translation take place in the cell?
What are the different types of genetic mutations and what effect do these mutations have on organisms?
What are the advantages and disadvantages of sexual and asexual reproduction?

Conceptual:

What does the structure of DNA reveal about its function?
What does the structure of RNA reveal about its function?
How are DNA and RNA utilized in the process of transcription?
How are mRNA, rRNA, and tRNA utilized in the process of translation?
Why do cells perform mitosis?
How are protein synthesis and mutations related?
How is the function of a protein affected if the shape of the protein is changed (due to a mutation)?

Why do cells undergo the cell cycle, and what are the functions of each phase and subphase?
How do cells undergo the process of mitosis, and how do the daughter cells relate to the parent cells?
How does mitosis maintain genetic continuity?
Why is DNA replication referred to as “semiconservative''?
How is the structure of DNA and RNA different ?
How do the ethical implications of different types of DNA technology influence society?

Debatable:
To what extent should humans manipulate human reproduction and genetic characteristics?

MYP Objectives	**Summative assessment**	
Sciences **Design**	Common Assessments: ● Common formative assessment on DNA Structure and Replication / Protein Synthesis ● Common summative assessment on Molecular Genetics ● MYP Essay Prompt	Relationship between summative assessment task(s) and statement of inquiry: The CFAs help to monitor and determine student progress as we move through the unit. This data informs the teacher of which students to accelerate, and which to remediate prior to the unit summative. The summative assessments serve to test students’ mastery of the learning targets at the proficient and distinguished level of the Achievement Level Descriptors for Biology.

Unit Objectives:

Learning Activities and Experiences	**Inquire & Obtain:**	**Evaluate:**	**Communicate:**
Week 1: **Topic 1: DNA Replication** ● purpose of DNA replication ● steps of DNA replication	Common Openers & Closers for Unit 5: Molecular Genetics Molecular Genetics PPT 1: DNA Replication (Honors) Molecular Genetics PPT (On-Level)	DNA Modeling Error Analysis DNA Replication Practice Modeling DNA Schoology Lab DNA Extraction Lab DNA Extraction Lab V2 Bioman DNA Replication Interactive HHMI Biointeractive: DNA Missions	Unit 5 Study Guide

Week 1/2: **Topic 2: Protein Synthesis** • central dogma of genetics • purpose of protein synthesis • transcription • translation	Molecular Genetics PPT 2: Protein Synthesis (Honors) Transcription & Translation Notes (On-Level)	Protein Synthesis Race How Genes Work Exploration - Protein Synthesis Simulation - Transcribe & Translate a Gene Simulation - HHMI Biointeractive: DNA Missions Snork Amino Acid Activity Codon Bingo and Codon Bingo Student Worksheet	Common Formative Assessment (Topics 1 & 2)
Week 3: **Topic 2: DNA Mutations** • types of DNA mutations • causes of DNA mutations • connection between DNA mutations and evolution	Molecular Genetics PPT 2: Protein Synthesis (Honors continued)	DNA Mutations Consequences Lab The Genetics of Sickle Cell Anemia Mutations Practice Mutations Practice Worksheet	Genetics 3D Model
Week 3.5: **Topic 4: Biotechnology** • use and ethical considerations of biotechnology in forensics, medicine, and agriculture **Assess & Remediate** Common Summative Assessment & Unit Remediation	Molecular Genetics PPT 2: Protein Synthesis (Honors continued) Biotechnology Nearpod - Student Paced Lesson Genetic Engineering Nearpod - Student Paced Lesson	Biotech Ethics Scenarios with Biotech Ethics Work Tasks	Common Summative Assessment MYP Essay MYP D - Biotechnology CK12 Unit Remediation
Resources (hyperlink to model lessons and/or resources): All resources are available on schoology.			

Reflection: Considering the planning, process and impact of the inquiry

Prior to teaching the unit	During teaching	After teaching the unit