Unit 04: DNA and Genetics (Weeks 19-24)

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **6 weeks**
Status: **Published**

Standards Alignment

New Jersey Student Learning Standards

Practice 1. Asking questions (for science) and defining problems (for engineering)
Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Practice 3. Planning and carrying out investigations
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

Select appropriate tools to collect, record, analyze, and evaluate data.

Practice 5. Using mathematics and computational thinking
Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).

Practice 6. Constructing explanations (for science) and designing solutions (for engineering)
Constructing explanations and designing solutions in 9–12 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.

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Practice 8. Obtaining, evaluating, and communicating information
Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.

Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.

Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Connections to the Nature of Science: Most Closely Associated with Practices
Scientific Investigations Use a Variety of Methods

New technologies advance scientific knowledge.

Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.

Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.

Scientific Knowledge is Open to Revision in Light of New Evidence

Most scientific knowledge is quite durable but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.

Crosscutting Statements
1. Patterns – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

Mathematical representations are needed to identify some patterns.

Connections to the Nature of Science: Most Closely Associated with Crosscutting Concepts
Science is a Way of Knowing

Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time.

Science is a Human Endeavor

Scientific knowledge is a result of human endeavor, imagination, and creativity.

Individuals and teams from many nations and cultures have contributed to science and to advances in engineering.

Technological advances have influenced the progress of science and science has influenced advances in technology.

LS1: From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function

Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)

All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)(secondary to HS-LS3-1)

Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself acomponent of the next level. (HS-LS1-2)

LS1.B: Growth and Development ofOrganisms

In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complexorganism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)

LS1.C: Organization for Matter and Energy Flow in Organisms

The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (suchas proteins or DNA), used for example to form new cells. (HS-LS1-6)

LS3: Heredity: Inheritance and Variation of Traits
LS3.A: Inheritance of Traits

Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used(expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory orstructural functions, and some have no as-yet known function. (HS-LS3-1)

LS3.B: Variation of Traits

In sexual reproduction, chromosomes can sometimes swap sectionsduring the process of meiosis (cell division), thereby creating new geneticcombinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmentalfactors can also cause mutations in genes, and viable mutations areinherited. (HS-LS3-2)
Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3)

LS4: Biological Evolution: Unity and Diversity
LS4.A: Evidence of Common Ancestry and Diversity

Genetic information provides evidence of evolution. DNA sequences varyamong species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred bycomparing the DNA sequences of different organisms. Such information isalso derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)

SCI.1-LS1	From Molecules to Organisms: Structure and Processes
SCI.1.LS1.A	Structure and Function
SCI.1.LS1.B	Growth and Development of Organisms
SCI.1.LS3.B	Variation of Traits
SCI.5.LS1.C	Organization for Matter and Energy Flow in Organisms
SCI.3-LS4	Biological Evolution: Unity and Diversity
SCI.3.LS4.A	Evidence of Common Ancestry and Diversity
SCI.HS-LS1	From Molecules to Organisms: Structures and Processes
SCI.HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
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-LS3	Heredity: Inheritance and Variation of Traits
SCI.HS-LS3-1	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
SCI.HS-LS3-2	Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
SCI.HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
1-LS3	Heredity: Inheritance and Variation of Traits
1-LS3-1.LS3.A	Inheritance of Traits
2-LS4	Biological Evolution: Unity and Diversity

Integration of Career Readiness, Life Literacies and Key Skills

CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
CAEP.9.2.12.C.4	Analyze how economic conditions and societal changes influence employment trends and future education.
CAEP.9.2.12.C.5	Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures.
CAEP.9.2.12.C.6	Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business.

Technology / Integration of Computer Science and Design Thinking

CS.9-12.8.1.12.IC.3	Predict the potential impacts and implications of emerging technologies on larger social, economic, and political structures, using evidence from credible sources.
CS.9-12.8.2.12.EC.1	Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
CS.9-12.8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.

Interdisciplinary Connections: NJSLS for ELA, Social Studies, Science and/or Math Section

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.
LA.RL.9-10.2	Determine a theme or central idea of a text and analyze in detail its development over the course of the text, including how it emerges and is shaped and refined by specific details and provide an objective summary of the text.
LA.RL.9-10.3	Analyze how complex characters (e.g., those with multiple or conflicting motivations) develop over the course of a text, interact with other characters, and advance the plot or develop the theme.
LA.RL.9-10.4	Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language evokes a sense of time and place; how it sets a formal or informal tone).
LA.RL.9-10.5	Analyze how an author's choices concerning how to structure a text, order events within it (e.g., parallel plots), and manipulate time (e.g., pacing, flashbacks) create specific effects (e.g., mystery, tension, or surprise).
LA.RL.9-10.6	Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.

Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media

LiteracyNew Section

see Crosswalks

21st Century Life and Careers

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CAEP.9.2.12.C.6	Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business.

Stage I: Desired Results

Transfer/Overview/Rationale

Transfer / Overview / Rationale

Unit Rationale

The purpose of this unit…

DNA is the universal code for living things, which is the key to understanding how living things form, function, and ultimately how they are connected to one another. Understanding how DNA functions is imperative to understanding how it codes for proteins, which in turn can be passed on during reproduction in different patterns of inheritance.

Meaning

Essential Questions

Essential Questions

- **How does DNA code for protein?**
- **How does sexual reproduction ensure diversity?**
- **How do mutations occur and affect gene expression?**
- **In what ways can traits be inherited?**

Enduring Understanding/Indicators of Understanding

Enduring Understanding/Indicators of Understanding

- **DNA is the molecule that codes for proteins in living organisms.**
- **Mitosis is the process of new cells deriving from preexisting cells.**
- **Creation of sex cells occurs through meiosis and genetic diversity occurs from crossing over.**
- **Gene expression is regulated by the cell and mutations can affect this expression and can also be influenced by environmental factors.**
- **Inheritance of traits is complex and can occur through multiple different patterns.**

Acquisition (Student Learning Objectives)

Knowledge

Knowledge

Students will know…

- **DNA is an inherited molecule that codes for proteins which in turn codes traits.**
- **DNA is a double helix of made of individual subunits known as nucleotides**
- **Nucleotides are made of: Deoxyribose, a phosphate group, and a nitrogen base**
- **DNA replication is the process of DNA making an identical copy of itself that occurs during interphase of the cell cycle**
- **Nitrogen bases include Adenine, Thymine, Cytosine, and Guanine. Adenine and Thymine are base pairs, meanwhile Guanine and Cytosine are base pairs.**
- **Purines and Pyrimidines**
- **Chargaff's Rule**

- **Garrod's Enzyme**
- **Protein synthesis occurs in three steps: Transcription, translation, and elongation**
- **mRNA is used during Transcription**
- **Translation uses tRNA**
- **Amino acids are assembled during elongation**
- **Codon chart for amino acid sequence in polypeptides forming proteins**
- **Mutagens are environmental factors that can cause mutations, such as smoking, UV rays, and pollution**
- **Mutations include addition, deletion, duplication, point and frameshift**
- **The cell cycle includes: Interphase (S1, G, S2) M phase (Prophase, Metaphase, Anaphase, Telophase and Cytokinesis)**
- **Mitosis is the creation of identical diploid cells**
- **Meiosis is the creation of non-identical haploid cells**
- **Meiosis includes two phases (Interphase, Prophase I, Metaphase I, Anaphase I, Telophase I, Prophase II, Metaphase II, Anaphase II, Telophase II)**
- **Meiosis is the process of chromosomes being replicated, rearranged, and divided, in order to prepare for sexual reproduction and diversity within offspring.**
- **Variation as a result of Crossing Over, Random Assortment of Chromosomes, Gene mutations, nondisjunction**
- **Cancer is the uncontrolled division of cells**
- **Alleles are all of the versions of a trait**
- **Phenotypes show physical characteristics, genotypes are the genes present**
- **Punnett squares show the probability of inheritance and are used to show both genotypic and phenotypic ratios**
- **Types of genetic crosses include: Monohybrid, dihybrid, sex-linked, multiple alleles/co-dominance, incomplete dominance**
- **Pedigrees are used to show genotypes and phenotypes within a family tree**

Skills

Skills

Student will be skilled at …

- **Extract DNA from living cells**
- **Solve word problems while determining genotypic and phenotypic ratios in genetic crosses**
- **Use probability to determine the likelihood of potential outcomes**
- **Research information and application of materials to create a genetic disorder project**

Stage 3: Learning Plan

Resource and Mentor Texts

Resources and Mentor Texts

- **Teacher derived notes**
- **Powerpoint/Google Slides presentation**
- **Worksheets**
- **Articles**
- **Lab materials**

Formative Assessment Strategies

Formative Assessment Strategies

- **Informal assessments (All call, thumbs up, Kahoot)**
- **Daily Do-Nows**
- **Exit tickets (Short answer responses, feedback forms)**
- **Quizzes**
- **Lab reports**

Learning Activities/Unit of Study

Learning Activities/Unit of Study

- **Lectures and notes on the DNA, Mitosis and Meiosis, and Genetics**
- **Cheek cell DNA extraction lab (With extended lab questions)**
- **DNA Origami**
- **Mutation word find**
- **Protein synthesis practice**
- **Protein Synthesis Lego Lab**
- **Mitosis serum brochure**
- **Microscope Mitosis phases identification (With extended lab questions)**
- **Mitosis webquest**
- **Genetic disorder project**
- **Blood typing lab (With extended lab questions)**
- **Make a baby lab**
- **Practice crosses**
- **Practice Pedigree**
- **Make a pedigree**
- **Webquests**

Modifications and/or Accommodations

Suggested Modifications (ELL, Sp. Ed, GIfted, At-risk of Failure)

English Language Learners

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how

much time they have to complete an assignment.

Students with 504 Plans

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Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

Modify/Change Activities: Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just

may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.