Unit #4: Genetics

Content Area: **Science**
Course(s): **Biology**
Time Period: **Third Marking Period**
Length: **8 Weeks**
Status: **Published**

Unit Overview

Genetics

DNA is the universal code for life; it enables an organism to transmit hereditary information and, along with the environment, determines an organism's characteristics. The work of Gregor Mendel led to the identification of DNA as the genetic material of living things as well as the discovery of its double helical structure. DNA carries the gentic code and the fundamental instructions that operate cells, interact with the environment and build organisms. It is passed along to new generations in every living thing on the planet.

STAGE 1- DESIRED RESULTS

Standards- 2020 New Jersey Student Learning Standards- Science

SCI.9-12.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.9-12.HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
SCI.9-12.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.9-12.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.9-12.HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
SCI.9-12.HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
SCI.9-12.HS-LS4-2	Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Science and Engineering Practices

- Analyzing and Interpreting Data
- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions
- Developing and Using Models
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information
- Planning and Carrying Out Information
- Using Mathematics and Computational Thinking

Cross Cutting Concepts

- Cause and Effect
- Energy and Matter
- Influence of Engineering, Technology, and Science on Society and the Natural World
- Interdependence of Science, Engineering, and Technology
- Patterns
- Scale, Proportion, and Quantity
- Stability and Change
- Structure and Functions
- Systems and System Models

Disciplinary Core Ideas

Life Sciences

- LS1A: Structure and Functions
- LS1B: Growth and Development of Organisms
- LS1C: Organization for Matter and Energy Flow in Organisms
- LS1D: Information Processing
- LS2A: Interdependent Relationships in Ecosystems
- LS2B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2C: Ecosystems Dynamics, Functioning, and Resilience

- LS2D: Social Interactions and Group Behavior
- LS3A: Inheritance of Traits
- LS3B: Variation of traits
- LS4A: Evidence of Common Ancestry and Diversity
- LS4B: Natural Selection
- LS4C: Adaptation
- LS4D: Biodiversity and Humans

Earth and Space Sciences

- ESS1A: The Universe and its Stars
- ESS1B: Earth and the Solar System
- ESS1C: The History of Planet Earth
- ESS2A: Earth Materials and Systems
- ESS2B: Plate Tectonics and Large-Scale Systems
- ESS2C: The Role of Water in Earth's Surface Processes
- ESS2D: Weather and Climate
- ESS2E: Biogeology
- ESS3A: Natural Resources
- ESS3B: Natural Hazards
- ESS3C: Human Impacts on Earth Systems
- ESS3D: Global Climate Change

Engineering. Technology. and Applications of Science

- ETS1A: Defining and Delimiting an Engineering Problem
- ETS1B: Developing Possible Solutioins
- ETS1C: Optimizing the Design Solution

Essential Questions

How does an organism pass its characteristics on to its offspring?

How can you predict the outcome of a genetic cross?

How can interactions between alleles, genes, and the environment affect an organism’s traits?

How does studying the human genome help us draw conclusions about the inheritance of traits?

How do we study the human genome, and what have we learned so far?

How did scientists determine that DNA is responsible for storing, copying, and transmitting genetic information?

How was the basic structure of DNA discovered?

How do cells copy their DNA?

What is RNA?

How do cells make proteins?

What happens when a cell's DNA changes?

How do cells regulate gene expression?

Enduring Understanding

DNA is the universal code for life; it enables an organism to transmit hereditary information and, along with the environment, determines an organism's characteristics.

Students will know…

Genetics, allele, fertilization, trait hybrid, allele, segregation, genotype, phenotype, probability, independent assortment, homozygous, heterozygous, codominance, incomplete dominance, polygenic, diploid, haploid, meiosis, crossing over, transformation, bacteriophage, base pairing, replication, telomere, RNA, transcription, translation, genetic code, codon, gene expression, mutation, operon, differentiation, genome, karyotype, pedigree, sex chromosome, nondisjunction, gel electrophoresis.

Predictable misconceptions

Students equate phenotype and genotype.

Although students are familiar with the word gene, many cannot explain the chemical basis of inheritance.

Students often fail to appreciate the importance of other genetic material, such as RNA.

Students frequently misidentify the products of translation as mRNA or amino acids.

Students often fail to understand the importance of regulatory genes.

Students often think that dominant traits are more common in a population.

Students may think that inheriting DNA sequences for a disorder will mean the individual always developes the disorder.

Students will be able to...

Describe Mendel's studies and conclusions about inheritance.

Describe what happens during segregation.

Explain how geneticists use the principles of probability to make Punnett Squares.

Explain the principle of independent assortment.

Explain how Mendel's principles apply to all organisms.

Describe the other patterns of inheritance.

Explain the relationship between genes and the environment.

Contrast the number of chromosomes in body cells and in gametes.

Summarize the events of meiosis.

Contrast meiosos and mitosis.

Describe how alleles from different genes can be inherited together.

Identify the types of human chromosomes in a karyotype.

Describe the patterns of the inheritance of human traits.

Explain how pedigrees are used to study human traits.

Explain how small changes in DNA cause genetic disorders.

Summarize the problems caused by nondisjunction.

Summarize the process of bacterial transformation.

Describe the role of bacteriophages in identifying genetic material.

Identify the role of DNA in heredity.

Identify the chemical components of DNA.

Discuss the experiments leading to the identification of DNA as the molecule that carries the genetic code.

Describe the steps leading to the development of the double-helix model of DNA.

Summarize the events of DNA replication.

Compare DNA replication in prokaryotes with that of eukaryotes.

Contrast RNA and DNA.

Explain the process of transcription.

Identify the genetic code and explain how it is read.

Summarize the process of translation.

Describe the "central dogma" of molecular biology.

Define mutations and describe the different types of mutations.

Describe the effects mutations can have on genes.

Describe gene regulation in prokaryotes.

Explain how most eukaryotic genes are regulated.

Relate gene regulation to development in multicellular organisms.

STAGE 2- EVIDENCE OF LEARNING

Formative Assessment

- 3- Minute Pause
- A-B-C Summaries
- Analogy Prompt
- Choral Response
- Debriefing
- Exit Card / Ticket
- Hand Signals
- Idea Spinner
- Index Card Summaries
- Inside-Outside Circle Discussion (Fishbowl)
- Journal Entry

- Misconception Check
- Observation
- One Minute Essay
- One Word Summary
- Portfolio Check
- Questions & Answers
- Quiz
- Self-Assessment
- Student Conference
- Think-Pair-Share
- Web or Concept Map

Authentic Assessments

Students will:

follow lab procedures

collect and graph data

form conclusions

complete assignments

develop and utilize models

cooperate in groups and with partners

complete a written science journal

maintain class notes and vocabulary in MacBook Airs

complete data tables

complete and interpret graphs

complete a project

complete quizzes

Benchmark Assessments

Chapter/Unit Tests

STAGE 3- LEARNING PLAN

Instructional Map

3rd Marking Period

Unit 4: Genetics

-
    - The Work of Gregor Mendel
    - Applying Mendel's Principles
    - Other Patterns of Inheritance
    - Meiosis
    - Human Heredity
    - Human Genetic Disorders
    - Studying the Human Genome

4th Marking Period

- DNA
    - Identifying the Substance of Genes
    - The Structure of DNA
    - DNA Replication
    - RNA and Protein Synthesis
        - RNA
        - Ribosomes and Protein Synthesis
        - Mutations
        - Gene Regulation and Expression

Modification/Differentiation of Instruction

Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding

- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language

- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

504 Plans

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep
- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

DI = ppt/air mac, co-operative learning (mixed ability)

ESL students: speaking, reading, writing, peer tutoring

SPEDs: restating, reading aloud, quided questions, additional problems and teacher's observations

Rephrase/Clarify/Repeat Directions

Study Guides

Extended Time on Tests / Assignments

Modify Tests / Assignments

Visual Aides

Word Bank

Use a Calculator

Repeated Drill and Practice

Teacher Notes

Preferential Seating

Oral Directions

Use of Additional Reference Materials

Break Down Assignments into Smaller Tasks

Academic Ability

1. Struggling: Think--Pair-- Share with gifted students.

2. Gifted: Think-- Pair-- Share with struggling students.

Modification Strategies

- Cooperative Grouping
- Extended Time
- Frequent Breaks
- Highlighted Text
- Interactive Notebook
- Modified Test
- Oral Directions
- Peer Tutoring
- Preferential Seating
- Re-direct
- Repeated Drill and Practice
- Shortened Assisgnment
- Teacher Notes
- Tutorials
- Use of Additional Reference Materials
- Use of Audio Resources

Differentiation Strategies

High Preparation

- Alternative Assessments
- Choice Boards
- Games and Tournaments
- Group Investigations
- Guided Reading
- Independent Research / Project
- Interest Groups
- Learning Contracts
- Leveled Rubrics
- Literature Circles

- Multiple Intelligence Options
- Multiple Texts
- Personal Agendas
- Project Based Learning (PBL)
- Stations / Centers
- Think-Tac-Toe
- Tiered Activities / Assignments
- Varying Graphic Organizers

Low Preparation

- Choice of Book / Activity
- Cubing Activities
- Exploration by Interest (using interest inventories)
- Flexible Grouping
- Goal Setting With Student
- Homework Options
- Jigsaw
- Mini Workshops to Re-teach or Extend Skills
- Open-ended Activities
- Think-Pair-Share by Readiness, Interest, or Learning Style
- Use of Collaboration
- Use of Reading Buddies
- Varied Journal Prompts
- Varied Product Choice
- Varied Supplemental Materials
- Work Alone / Together

Horizontal Intergration- Interdisciplinary Connections

See Appendix

Vertical Integration- Discipline Mapping

Students will have been exposed to the Performance Expectations for Life Sciences and Engineering Design outlined in the Next Generation Science Standards (NGSS) starting in 1st grade through Biology, which is offered during the Freshman year of High School. Science classes are designed around the Performance Expectations, Science and Engineering Practices, Discplinary Core Ideas, and Croscutting Concepts in the NGSS. In grade 6, students complete a unit on "Diversity of Life". This leads into "Populations and Ecosystems" in grade 7. In grade 8 students study "Human Systems Interactions" and "Heredity and Adaptations." Biology, being a full year recquired course, will focus on having students gain a deeper understanding of the Performance Expectations outlined in the NGSS, particulary in Life Sciences and Engineering Design. Following Biology in 9th grade students will take Chemistry. After students will be able to chose from Physics, Anatomy and Physiology, Human Impact on the Environment, Forensics and Zoology.

Additional Materials

Pearson Successnet

Newsela