

Unit 1: Classical Genetics

Content Area: **Science**
Course(s):
Time Period: **Generic Time Period**
Length: **Approx. 7 Weeks**
Status: **Published**

Standards

Science Standards

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-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
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.

Technology Standards

TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
TECH.9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

Social Emotional Learning

HE.9-12.2.1.12.EH.1	Recognize one's personal traits, strengths, and limitations and identify how to develop skills to support a healthy lifestyle.
HE.9-12.2.1.12.EH.3	Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
HE.9-12.2.1.12.SSH.4	Demonstrate strategies to prevent, manage, or resolve interpersonal conflicts without harming self or others (defining and understanding the laws of consent and dating violence).

Section Title

Transfer Goals

At the end of this unit, students will use what they have learned to independently...

- i. comprehend that physical appearance is determined by the combination of genes from each parent
- ii. determine the probability of a trait in certain offspring by using Punnett squares
- iii. understand that genetic information is passed from generation to generation

Essential Questions

- How are characteristics of one generation passed to the next?
- How are the characteristics from one generation related to the previous generation?
- How can individuals of the same species and even siblings have different characteristics?
- How do living organisms pass traits from one generation to the next?
- Why don't all living things look the same?

Understandings

Students will understand that...

- The variety within a species results in a continuity of structure and function from one generation to the next.
- It important for organisms to inherit genetic information in a variety of ways.
- Genetic information is passed from generation to generation
- Organisms reproduce sexually to provide variation within a species.
- Species transcends individual life spans through reproduction.

Critical Knowledge and Skills

Knowledge

Students will know:

- Pedigrees illustrate the inheritance of a specific trait throughout generations.
- The following vocabulary terms and how they relate to inheritance: Punnett Square, Trait, Probability, Homozygous, Heterozygous, Genotype, Phenotype, X-Linked Inheritance, Allele, Gene, Dihybrid Cross, Testcross, Purebred, P generation, F1 Generation, Law of Independent Assortment, F2 Generation, Incomplete Dominance, Codominance, Pedigree, Law of Segregation, Dominant, Recessive, Progeny, Wild Type Phenotype, Mutant Phenotype, Mutation, Trihybrid Cross, Hemophilia, Monohybrid Cross, Autosomal Dominant, Autosomal Recessive
- Gregor Mendel is considered the "Father of Genetics."
- How genetic traits are passed on from generation to generation
- How to utilize a punnett square to determine the probability of a certain trait in offspring
- Mendel's Laws of Independent Assortment and Law of Segregation.

Skills

Students will be able to:

- Read non-fictional text for information while employing reading strategies. (For ex. Blue People of Troublesome Creek)
- Construct and interpret Punnett Squares (Monohybrid, Dihybrid, and Trihybrid Crosses)
- Predict the probability of the inheritance of specific traits
- Scientific skills (asking questions, gathering and analyzing data, making predictions, drawing conclusions based on evidence)

Assessment and Resources

School Formative Assessment Plan (Other Evidence)

- Daily Do Nows
- Homework
- In-Class Discussion (ex. Class Dojo Participation)
- Labs
- Quizzes
- Reading and analysis Questions (ex. Blue People of Troublesome Creek)

School Summative Assessment Plan

- Classical Genetics Unit Test Part 1 (Vocabulary and Content)
- Classical Genetics Unit Test Part 2 (Crosses and Probability)

- Genetics Final Exam (Located in Unit 3)

Supplementary Resources



[Hemophilia and Porphyria: Tainted Blood](#)

Technology Integration and Differentiated Instruction

Technology Integration

- **Google Products**
 - Google Classroom - Used for daily interactions with the students covering a vast majority of different educational resources (Daily Notes, Exit Tickets, Classroom Polls, Quick Checks, Additional Resources/ Support, Homework, etc.)
 - GAFE (Google Apps For Education) - Using various programs connected with Google to collaborate within the district, co-teachers, grade level partner teacher, and with students to stay connected with the content that is covered within the topic. Used to collect data in real time see results upon completion of the assignments to allow for 21st century learning.
- **One to One Student laptop** - All students within the West Deptford School District are given a computer, allowing for 21st century learning to occur within every lesson/topic.
- **Additional Support Videos** - The video websites below are just examples of videos that can be used to support each of the Lessons within this Topic
 - Bozeman Science, Amoeba Sisters, Khan Academy

Differentiated Instruction

- Gifted Students (N.J.A.C.6A:8-3.1)
 - Within each lesson, the Gifted Students are to be given the Enrichment Questions
 - These questions are to extend the knowledge of each portion of the lesson.
 - Performance Task
 - Additional practice was provided for students that provided a higher level of thinking for the concepts.
- English Language Learners (N.J.A.C.6A:15)
 - Within each lesson, the English Language Learners are given three levels of questioning. Each level is accommodating to the level of learning that the individual student(s) is learning at.
 - Beginning
 - Intermediate
 - Advanced

- All assignments can be created in the student's native language if needed.
- Work with ELL Teacher to allow for all assignments to be completed with extra time.
- Risk Students (N.J.A.C.6A:8-4.3c)
 - Work with the I&RS Team to reach the needs of students.
 - Mentors provided
 - Offer additional supports as needed (after school help, parent contacts, frequent checks for understanding, etc.)
- Special Education Students (N.J.A.C.6A:8-3.1)
 - Frequent checks for understanding
 - Preferred seating assignments
 - Multiple representations- Encourage and allow tables, graphic organizers, etc.
 - Hard copy of notes
 - Extend the time needed to complete assignments/assessments
 - Provide a copy of grading rubrics for projects/labs
 - Provide a copy of a model representation for projects
 - Clarification of directions/instructions
 - Use of technology when appropriate
 - Repeat/rephrase instructions as needed

Interdisciplinary Connections

- **MATH -**
 - Probability
 - The product rule with crosses
- **ELA -**
 - Reading Comprehension
 - Blue People of Troublesome Creek
- **SOCIAL STUDIES -**
 - Hemophilia and the Royal Family
 - Students will use pedigrees to track hemophilia through the royal family
 - We will discuss how hemophilia can be blamed for the fall of the Russian Royal Family
 - The Blue People of Troublesome Creek
 - In-Class Discussion of the mutation that was seen in the Blue People of Troublesome Creek
- **WORLD LANGUAGES -**
- **VISUAL/PERFORMING ARTS -**
- **APPLIED TECHNOLOGY -**
- **BUSINESS EDUCATION -**
- **GLOBAL AWARENESS -**

Learning Plan / Pacing Guide

Week 1:

- Introduction to Genetics
- Furry Family Online Intro to Punnett Square Activity
- Mendelian Genetics Vocabulary Terms
- Begin Mendelian Genetics Notes
- Probability Lab

Week 2:

- Continue Mendelian Genetics Notes
- Probability Worksheet
- Bill Nye Greatest Discoveries Video and Questions
- Famous Geneticists Project
- Practice Monohybrid Crosses

Week 3:

- Continue Mendelian Genetics Notes
- Practice More Monohybrid Crosses
- Begin Dihybrid Crosses
- End of Week 3: Genetics Quiz #1

Week 4:

- Ridgeback and Jurassic Dihybrid Crosses Worksheet
- Notes on Karyotypes (In Mendelian Genetics PPT)
- Karyotype Worksheet
- Genetic Disorders Project

Week 5:

- Notes on Sex-Linked Traits (In Mendelian Genetics PPT)
- Sex-Linked Traits Practice Problems
- Blue People of Troublesome Creek Reading and Analysis Questions
- Make a Baby Lab
- Genetics Quiz #2

Week 6:

- Hemophilia and Porphyria Video
- Notes and Practice on Pedigrees
- Classical Genetics Study Guide
- Play Classical Genetics Review Game (BINGO, Kahoot!, etc.)
- **Classical Genetics Unit Test Part 1 (Vocabulary and Content)**
 - The content/vocabulary portion of this exam is located on LINKIT!
 - Blood Typing Section is on paper

Week 7:

- **Classical Genetics Unit Test Part 2 (Crosses)**
 - All on paper

Unit 2: Molecular Genetics

Content Area: **Science**
Course(s): **GENETICS**
Time Period: **Generic Time Period**
Length: **9 weeks**
Status: **Published**

Transfer Goals

Mitosis is the division of somatic (body cells) and Meiosis is the process of creating gametes. Both involve the copying of chromosomes (genetic material). An offspring receives one allele from each parent. Crossover occurs during Meiosis when the tetrads line up. This allows for genetic diversity. DNA is replicated prior to division which enables a cell to end up with the correct number of chromosomes after division.

Standards

Social Emotional Learning Standards

HE.9-12.2.1.12.EH.1	Recognize one's personal traits, strengths, and limitations and identify how to develop skills to support a healthy lifestyle.
HE.9-12.2.1.12.EH.3	Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
HE.9-12.2.1.12.SSH.4	Demonstrate strategies to prevent, manage, or resolve interpersonal conflicts without harming self or others (defining and understanding the laws of consent and dating violence).

Science Standards

SCI.HS.LS1.A	Structure and Function
SCI.HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
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-LS4	Biological Evolution: Unity and Diversity
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

Technology Standards

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Concepts

Essential Questions

- How does our DNA differ from other organisms?
- How is the continuity of life sustained through reproduction and development?
- What causes cancer?
- What is the purpose of DNA?
- Why does sexual reproduction result in variations?
- Why is crossover important in sexual reproduction?

Understandings

- It is important for organisms to inherit genetic information in a variety of ways.
- This variety results in a continuity of structure and function from one generation to the next.
- The defining moment in meiosis is when the cell goes from diploid to haploid.
- Species transcend individual life spans through reproduction.
- Genetic Diversity is important and occurs when crossing over occurs in Meiosis.
- There are different types of cancer that affect different organs of the body.
- The cause of cancer.
- DNA is the blueprint of creating proteins, which are the building blocks of life.

Critical Knowledge and Skills

Knowledge

Students will know:

- The events in mitosis and meiosis.
- That the stages of mitosis are easily distinguished when seen in images.
- Sexual reproduction produces offspring with a combination of genes from mother and father.
- Homolog separation and recombining is the method of diversifying genes.
- What causes cancer and how we can prevent it.
- The steps of Protein Synthesis, DNA Replication, Transcription, and Translation

Skills

Students will be able to:

- Recognize images of the stages of mitosis in an onion cell.
- Diagram and identify the stages of mitosis in pictures.
- Summarize the stages of mitosis.
- Compare and contrast the stages of meiosis and mitosis.
- Diagram the complex stages of meiosis.
- Manipulate models of chromosomes as they go through meiosis.
- Research a certain cancer and produce an informational poster on that cancer.
- Relay the steps of Protein Synthesis, DNA Replication, Transcription, and Translation

Assessment and Resources

School Formative Assessment Plan (Other Evidence)

- Quizzes
- Labs
 - Banana Lab
- Classwork
- Homework
- Projects
 - Genetic Disorders Project
- Daily Do Nows
- Performance Tasks

School Summative Assessment Pan

- Molecular Genetics Unit Test
- Genetics Final Exam (Located in Unit 3)

Primary Resources

Supplementary Resources

[Mystery of Photo 51 - The Story of Rosalind Franklin](#)

[PBS Nova: Cracking the Code of Life](#)

Technology Integration and Differentiated Instruction

Technology Integration

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 - Hard copy of notes
 - Extend the time needed to complete assignments/assessments
 - Provide a copy of grading rubrics for projects/labs
 - Provide a copy of a model representation for projects
 - Clarification of directions/instructions
 - Use of technology when appropriate
 - Repeat/rephrase instructions as needed

Interdisciplinary Connections

MATH -

ELA - Vocabulary; Article Readings and in-class discussion

SOCIAL STUDIES - Mystery of Photo 51 - The Story of Rosalind Franklin, The History of DNA; Scientific Experiments to discover DNA

WORLD LANGUAGES - Vocabulary: Sexual Reproduction, Meiosis, Mitosis, etc.

VISUAL/PERFORMING ARTS - Genetic Topic Research Project (Students create video, power point, etc. about any topic in Genetics)

APPLIED TECHNOLOGY - Genetic Topic Research Project (Students create video, power point, etc. about any topic in Genetics)

BUSINESS EDUCATION -

GLOBAL AWARENESS - Research Scientists involved in the discovery of DNA, understand the hardship women had to face in the scientific field in the past and now (Rosalind Franklin)

Learning Plan / Pacing Guide

Week 1:

- Intro to DNA
- DNA Structure Worksheet
- Banana DNA Extraction Lab
- Molecular Genetics Vocabulary
- Mystery of Photo 51 - The Story of Rosalind Franklin

Week 2:

- Finish The Mystery of Photo 51 - The Story of Rosalind Franklin
- DNA Origami
- Structure of DNA Webquest
- Notes on DNA Replication
- DNA Replication Worksheet
- Notes on DNA
- DNA Replication Project

Week 3:

- Review DNA Replication
- Notes on RNA
- RNA Worksheet
- Review DNA Replication and RNA
- Molecular Genetics Quiz #1
- Protein Synthesis Notes and Vocabulary
- Protein Synthesis Review Worksheet

Week 4:

- Protein Synthesis and Coding Worksheet
- Protein Synthesis Quiz
- DNA, RNA, Protein Synthesis BINGO
- "Cracking the Code of Life"

Week 5:

- Finish "Cracking the Code"
- Notes and Worksheet on the Cell Cycle
- Cancer Notes
- Cancer Research Project

Week 6

- Quiz on Cancer and the Cell Cycle
- Mitosis Webquest
- Mitosis Notes
- Mitosis Vocabulary
- Cell Cycle and Mitosis Worksheet

Week 7

- Mitosis Card Project
- Review Microscopes
- Start Mitosis Lab (Onion Root Tip)

Week 8:

- Finish Mitosis Lab (Onion Root Tip)
- Meiosis Notes
- Meiosis Review Worksheet
- Comparing Meiosis and Mitosis Venn Diagram
- Comparing Meiosis and Mitosis Worksheet
- Meiosis Webquest

Week 9:

- Review DNA Replication
- DNA Structure and Replication Webquest
- Mitosis/Meiosis Review Questions
- Review Games for Molecular Genetics Unit Test (Kahoot!, BINGO, etc.)
- Molecular Genetics Unit Test

Unit 3: Population Genetics

Content Area: **Science**
Course(s): **GENETICS**
Time Period: **Generic Time Period**
Length: **Approx. 4 weeks**
Status: **Published**

Standards

Technology Standards

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Science Standards

SCI.HS.LS3.A	Inheritance of Traits
SCI.HS.LS3.B	Variation of Traits
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-LS4-5	Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of

	new species over time, and (3) the extinction of other species.
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-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
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-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
SCI.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.

Transfer Goals

Students will be able to provide data, analyze theories, and generate proof for the process of evolution that connects humans genetically with all other organisms.

Concepts

Essential Questions

- Do people in a particular area have similar characteristics?
- How can the United States being a “melting pot” be an advantage for survival?
- What affects our outcomes in life, “Nature vs. Nurture?”
- How has life on earth changed throughout time?
- What enable some species to carry on genetically while others become extinct?
- How do different environments affect evolution of the same species?
- What are some of the changes due to environment that could potential affect our own species adaptation?
- How do genetic mutations and recombination of genes during meiosis enable evolution to occur?
- How could life on Earth change to become increasingly complex?

Understandings

- Certain natural Earth processes can affect DNA and how it combines together.

- Genes in populations remain constant over time if certain conditions hold true.
- There are certain mechanisms that help to alter genes in populations to form new traits: selection, mutation, migration, random genetic drift, meiotic drive.
- Use Darwin's data to see how he came up with his principles of evolution (including natural selection and common descent) providing a scientific explanation for the history of life on Earth.
- Humans have accelerated the natural process through gene manipulation, clear-cutting forests, ozone depletion, etc. Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring
- How to calculate gene frequencies of various populations
- Natural selection is the process by which evolution occurs.
- Variation exists in all species and allows some individuals to be better able to survive in a particular environment than others.

Critical Knowledge and Skills

Knowledge

Students will know:

- That genes in populations change when subject to certain natural conditions.
- Selection, mutation, migration, random genetic drift, and meiotic drive are mechanisms to alter gene frequencies.
- There are many examples describing each of the above mechanisms for allelic change.
- Darwin's journey and finches that lead him to his theory explained in his book, "The Evolution of Species by Natural Selection."
- Evolution occurs as a result of a combination of the following factors: Ability of a species to reproduce; Genetic variability of offspring due to mutation and recombination of genes; Finite supply of the resources required for life
- How to solve problems for gene frequency using algebra.

Skills

Students will be able to:

- calculate frequencies of alleles in generations
- analyze how migration affects allele frequencies
- defend how variations lead to adaptations.
- defend how species adapt to their environment.

- distinguish between the 5 assumptions of natural selection

Assessment and Resources

School Formative Assessment Plan (Other Evidence)

- Quizzes
- Labs
- Classwork
- Homework
- Projects
- Genetics Topic Research Project
- Daily Do Nows
- Performance Tasks

School Summative Assessment Plan

- Population Genetics Unit Test
- Genetics Final Exam

Primary Resources

Supplementary Resources

[PBS Nova Documentary - What Darwin Never Knew](#)

Technology Integration and Differentiated Instruction

Technology Integration

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 - Provide a copy of a model representation for projects
 - Clarification of directions/instructions
 - Use of technology when appropriate
 - Repeat/rephrase instructions as needed

Interdisciplinary Connections

MATH - Calculating allelic frequencies using algebraic equations

ELA - Article Readings and In-Class Discussion

SOCIAL STUDIES - The History of Darwin

WORLD LANGUAGES -

VISUAL/PERFORMING ARTS -

APPLIED TECHNOLOGY - Genetics Topic Presentation Project

BUSINESS EDUCATION -

GLOBAL AWARENESS - Discussion of how migration adds alleles to a population causing genetic drift (bottleneck effect, founder effect, etc.)

Learning Plan / Pacing Guide

Week 1:

- Genetics Topic Research Project and Presentations
- Population Genetics Vocabulary
- Notes on Population Genetics

Week 2:

- Population Genetics Worksheet
- Microevolution vs. Macroevolution Worksheet
- Hardy-Weinberg Practice Problems
- Hardy-Weinberg Worksheet

Week 3:

- "Rise of the Super Bugs"
- More Hardy-Weinberg Practice
- Genetic Drift M&M Lab

Week 4:

- Review for Final Exam (Study Guides)
- Genetics Final Exam

