Unit 5 - Traits and reproduction

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **Full Year**
Status: **Published**

Unit Overview

In the Traits and Reproduction unit, students take on the role of student genetic researchers, working with the fictional bioengineering firm, Bay Medical Company. Bay Medical Company is attempting to breed spiders with the type of silk that can be used for medical applications (e.g., to create artificial tendons). The student genetic researchers are faced with the challenge of explaining how the silk flexibility traits of closely related spiders can vary, which serves as the anchor phenomenon for the unit. To explain this mystery, students create physical models, read articles, and observe genetics in action, using the Traits and Reproduction Simulation. This powerful and engaging digital tool allows students to observe and breed spiders, making connections between what happens inside cells and how this affects the traits of an organism. Through their research, students learn about the role proteins, genes, and sexual reproduction play in trait variation. They are able to apply what they have learned about spiders to a human context.

Enduring Understandings

Why do traits vary, and why do they vary even between parents and offspring and among siblings?
What determines an organism's traits at the molecular scale?
How can organisms make different protein molecules for a particular feature?
Why do some organisms make one type of protein for a feature and other organisms make two?
How do organisms get their genes?
How does sexual reproduction result in variation among offspring?

Essential Questions

The traits of an organism are determined by the structure of protein molecules and the interactions of those protein molecules in cells.
Genes are instructions for producing proteins.
Through sexual reproduction, an organism inherits a random combination of gene versions from its parents.

Learning Objectives

By the end of this unit, students will know:
The function of a protein molecule depends on its structure and how it interacts with other protein molecules.
Differences in the structure of protein molecules affect how they connect to other protein molecules. This can result in different traits.
The structure of molecules determines how they function at a molecular scale, which determines the properties of the object they make up.

Organisms can have different proteins in their cells for a particular feature.
Genes are instructions for proteins.
Each gene version provides a unique instruction to make a specific protein molecule in an organism's cells.
An organism has two copies of a gene for each feature.
The two copies of a gene for each feature can be the same version (homozygous) and provide instructions for only one type of protein.
The two copies of a gene for each feature can be different versions (heterozygous) and provide instructions for two types of proteins.
Organisms inherit their genes through sexual reproduction.
Each parent randomly passes on one of its two copies of each gene to its offspring. Each offspring, therefore, receives two copies of each gene, one from each parent.
Through sexual reproduction, each offspring can inherit a different combination of gene versions. Therefore, siblings can have different traits from each other and even from their parents.
Explore traits and proteins in the Sim and test the effect of changing protein molecules.
Read short articles about different kinds of spiders and how their silk traits are related to the protein molecules that make up the silk.
Build physical models of connected protein molecules to make silk with different levels of flexibility.
Read about the genes and proteins involved in hemophilia.
Use the Sim to investigate genes and their outcomes by making changes to genes and observing the effect on proteins and traits.
Engage in a physical model that highlights genes as instructions and introduces mutations.
Create visual models showing their explanations for how the spider offspring have different traits.
Read about identical and fraternal twins to learn how genes are passed on in sexual reproduction.
Investigate how genes are passed on when spiders in the Sim reproduce, and test the effects of random mutations during reproduction.
Model their understanding of how genes were passed on in the Darwin's bark spider family.

Standards: Content

MS-LS1-2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
MS-LS3-1	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
MS-LS3-2	Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Standards: Interdisciplinary

Assessment Evidence

Formative	Teacher observations, Class discussions, Lab Activities, Key concepts and vocabulary quizzes, Warm Ups, Open Ended Responses, Modeling, Simulations, Innovators Monthly Research
Summative	In correlation with the NJSLS, students must demonstrate the following as summative assessments: MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS-LS3-1: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. MS-LS3-2: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. MS-LS4-5: Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms Other summative assessments will include but are not limited to: lesson activities, summative tests, lab skills, demonstrations, and vocabulary quizzes
Alternative & Benchmark	Alternative assessments as required by student IEP/504/I&RS - Read to the student and chart oral responses. Word banks, sentence frames, oral responses, graphic organizers, observations, and anecdotal notes. Benchmark – LinkIt Benchmark Assessment, Teacher Generated Assessments
Assessment Evidence Resource	

Instructional Resources

Smartboard, Computers, Websites and digital interactives/models, Multi-media presentations, Video Streaming, Amplify Digital Curriculum, Generation Genius, BrainPop, Mystery Science, Microsoft 365, Primary and Secondary Source Documents, Lab Materials as needed, Amplify Readings, Labs, Simulations

Instructional Resource List

Curricular Mandates

Below are the curricular requirements as defined in NJ Administrative Code and Statute

	Amistad		Diversity, Equity, and Inclusion
	Holocaust		LGBT and Disabilities (Grades 6-12)
	Climate Change		Asian American & Pacific Islander

Social Emotional Learning (SEL) Competencies

NJ Social and Emotional Learning Competencies & Sub-Competencies

	Self-Awareness		Relationship Skills
	Responsible Decision-Making		Social Awareness
X	Self-Management		

21st Century Skills & Themes

X	Global and Cultural Awareness	X	Technology Literacy		Planning and Budgeting
X	Creativity and Innovation		Financial Institutions		Risk Management and Insurance
X	Information and Media Literacy		Digital Citizenship		Economic and Government Influences
X	Critical Thinking and Problem Solving		Credit Profile		Career Awareness and Planning
	Civic Financial Responsibility		Financial Psychology		