HILLSBOROUGH TOWNSHIP SCHOOL DISTRICT

SCIENCE CURRICULUM

BIOLOGY

AUGUST 2021

Biology
Course Overview

Biology is the study of complex mechanisms of life and interactions between organisms for survival. Students investigate explanations for the structure and functions of cells as the basic unit of life, of hierarchical organization of interacting organ systems, and of the role of specialized cells for maintenance and growth. Students analyze data and develop models to make sense of the relationship between DNA and chromosomes in the process of cellular division, which passes traits from one generation to the next. Students develop conceptual models of the role of DNA in the unity of life on Earth and use statistical models to explain the importance of variation within populations for the survival and evolution of species. Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions. Students construct explanations for the processes of natural selection and evolution and then communicate how multiple lines of evidence support these explanations. Students evaluate evidence of the conditions that may result in new species and understand the role of genetic variation in natural selection. Additionally, students apply concepts of probability to explain trends in population as those trends relate to advantageous heritable traits in a specific environment. Students construct explanations for the role of energy and the cycling of matter in organisms and ecosystems. They apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration, and they develop models to communicate these explanations. Students also understand organisms' interactions with each other and their physical environment and how organisms obtain resources. The diversity and interdependence of organisms and the various mechanisms by which living systems carry out the life process are stressed throughout the course.

The crosscutting concepts of patterns, cause and effect, scale, proportion, and quantity, systems and system models, interdependence of science, engineering, and technology, and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas.

In the Biology course performance expectations, students are expected to demonstrate grade-appropriate proficiency in the practices of science and engineering by asking questions and defining problems; developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

The Biology curriculum meets the requirements of the New Jersey Student Learning Standards for Science and helps to prepare students to meet and exceed the standards assessed by the NJDOE state assessments, such as the New Jersey Student Learning Assessments (NJSLA) -

Science through higher order application of various skills required for complete understanding of Biology.

Hillsborough Township Public Schools
Biology CP/H Curriculum

Unit Title	**Time Frame/Pacing**
Biology in Use	15 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:

- Slime Molds - Are they alive?
- Dog vomit fungus in NJ

Essential Questions:

- How is life defined?
- What makes something alive?
- How is life organized?
- How does structure determine the functioning of living things?
- How do scientists gather and analyze data to investigate specific phenomena?

Enduring Understandings

- Investigations of what makes something living or nonliving;
- How living things are organized from molecules to organisms;
- Systems of specialized cells within organisms help perform essential functions of life;
- Plan and carry out controlled investigations using the scientific process, collect and analyze data (both qualitative and quantitative) and construct explanations based on evidence.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

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

3-Dimensional Learning Components

Science and Engineering Practices	**Disciplinary Core Ideas (DCI)**	**Crosscutting Concepts**
Developing and Using Models • Develop and use a model based on evidence	**LS1.A: Structure and Function** • Multicellular organisms have a hierarchical	**Systems and System Models** • Models (e.g., physical, mathematical,

to illustrate the relationships between systems or between components of a system. **Engaging in argument from evidence** • Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student-generated evidence.	structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. • Systems of specialized cells within organisms help them perform the essential functions of life.	computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. • Patterns-Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-1), (HS-LS2-2), (HS-LS2-7)

ELA

- WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS2-7), (HS-LS4-6)

Computer Science and Design Thinking

- 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
- 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
- 8.2.12.EC.3 Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.

Career Readiness, Life Literacies, and Key Skills

- 9.2.5.CAP.1 Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.

Social-Emotional Learning Competencies

- **Self Management:** Recognize the skills needed to establish and achieve personal and educational goals.

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- **Social Awareness:** Demonstrate an awareness for the expectations for social interactions in a variety of settings.
- **Relationship Skills:** Utilize positive communication and social skills to interact effectively with others.

Learning Targets	Investigations/Resources	Formative Assessment
Students will analyze a model to explain that multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.	Pyramid of Life Model and Analysis	Do now/exit tickets based on Pyramid of Life concepts Models of Pyramid of Life
Use evidence collected to make an argument if yeast or seeds are alive. Students will practice designing controlled investigations as well as collecting and analyzing data in order to construct explanations.	Is it Alive? Inquiry activity:Students develop a checklist for characteristics that make something alive. Use checklist to evaluate several samples. Intro NGSS Activity	Argument from Is It Alive Inquiry Activity
Analyze similarities among organisms and differences from other groups. Construct explanations of ways these groups differ - including cell differences, ways of obtaining energy and reproductive strategies.	Survey of Life Inquiry Activity: Students observe groups of living organisms (animal, plant, fungi, protist and bacteria)	Student discussion of which characteristics describe each group of living organisms.
		Summative: Unit test including a practical for HS-LS1-2.

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this:

- Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.

Common Assessment(s)	Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

• **Common:** Characteristics of Life Assessment	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

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Unit Title	**Time Frame/Pacing**
Homeostasis in Cells and Systems	25 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:
- Homeostasis-Energy Drinks
- Feedback Loops- Video clip of Steel Magnolias or other Diabetic episode

Essential Questions:
- How does the structure of cells determine the functioning of cells to maintain homeostasis?
- How does the structure of the cell membrane allow essential molecules to enter and leave the cell?

Enduring Understandings

- Organelles have distinct functions but work together for optimal functioning of the cell.
- Cell transport requires mechanisms (such as active and passive transport) to maintain homeostasis to allow for survival within a given environment.
- Honors: Structure and Function of Macromolecules (Proteins, lipids, carbohydrates, nucleic acids)

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

3-Dimensional Learning Components

Science and Engineering Practices	**Disciplinary Core Ideas (DCI)**	**Crosscutting Concepts**
Planning and Carrying Out Investigations • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence,and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on	**LS1.A: Structure and Function** • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system.

the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. **Constructing Explanations and Designing Solutions** • Construct 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.	encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively. (HS-LS2-4)
- MP.4 Model with mathematics. (HS-LS2-4)
- HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-4)

ELA

- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-LS1-3)

Computer Science and Design Thinking

Computer Science:

- 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.

- 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.

Design Thinking:

- 8.2.12.EC.3 Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.

Career Readiness, Life Literacies, and Key Skills

- 9.2.5.CAP.1 Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.

Social-Emotional Learning Competencies

- **Self Management**: Recognize the skills needed to establish and achieve personal and educational goals.
- **Social Awareness**: Demonstrate an understanding of the need for mutual respect when viewpoints differ.
- **Responsible Decision-Making**: Develop, implement and model effective problem solving and critical thinking skills.

Learning Targets	Investigations/Resources	Formative Assessment
Comparison of various cell types (using microscopy) that lend to biodiversity on Earth. Modeling of cell transport Construct an explanation for how materials are transported into and out of cells. **Honors:** Demonstrate the concept of Osmoregulation (Structure and function of the kidney)	• Active and Passive Transport: Egg investigation (Osmosis, Hypertonic, Hypotonic, Isotonic solutions) • Transport through dialysis tubing (How does glucose enter a cell?) • Movement of water in and out of elodea/onion (Plasmolysis) • Amoeba Eats Two Paramecium • Neutrophil Phagocytosis	**Formative:** • Inquiry investigations • Class and small group discussions • POGIL (ex. Prokaryotic and Eukaryotic Cells and Eukaryotic Cell Structure:Organelles in Animal and Plant Cells) • Explanations for how cells reach homeostasis cellular transport using evidence generated from models • Red Rover molecule simulation

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this:

- Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking

more complex questions and exploring concepts in greater depth.	
Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Maintaining Homeostasis in Organisms Assessment	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

Hillsborough Township Public Schools
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Unit Title	Time Frame/Pacing
Matter and Energy in Ecosystems	40 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Photosynthesis
Phenomena:

- Air Plants or Giant Pumpkin
- Albino Corn vs. Green Corn
- Honors-Crown Shyness

Essential Questions:

- How are all organisms dependent on each other?
- How do living things use food for energy and to build new parts of the body?

Ecology
Phenomena:

- Cicada's role in the Food Web - How it changes in a year they are emerging, Heat Wave Kills 1 Billion Sea Creatures article
- Honors-Crown Shyness

Essential Questions:

- How are all organisms dependent on each other?
- How do living things use food for energy and to build new parts of the body?
- How is matter transferred and energy transferred/transformed in living systems?
- How do humans impact the cycling of matter and the flow of energy in a system?

Cellular Respiration
Phenomena:

- Marathon Runner

Essential Questions:

- How do living things use food for energy and to build new parts of the body?
- How is matter transferred and energy transferred/transformed in living systems?
- How do organisms regulate oxygen, carbon dioxide, water, and other molecules to maintain homeostasis?

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Enduring Understandings

- Photosynthesis converts light energy into chemical energy.
- Matter is assembled into other molecules needed by the cell.
- Matter and energy flow through levels of living systems with less energy being transferred up at each level.
- Cellular respiration breaks bonds to release energy to cells.
- Human activities have an impact on the cycling of matter and the flow of energy in Earth's systems.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- HS-LS1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
- HS-LS2-3 Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Developing and Using Models • Use a model based on evidence to illustrate the relationships between systems or between components of a system. • Develop a model based on evidence to illustrate the relationships between systems or components of a system. **Mathematical and Computational Thinking** • Use mathematical representations of phenomena or design solutions to support claims. **Constructing Explanations and Designing**	**HS-LS1C.1: Organization for Matter and Energy Flow in Organisms** • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. **HS-LS1C.2: 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	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scale. **Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. • Energy cannot be created or destroyed—it

Solutions • 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.	molecules (such as proteins or DNA), used for example to form new cells. **HS-LS1C.3: Organization for Matter and Energy Flow in Organisms** • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. **HS-LS1C.4: Organization for Matter and Energy Flow in Organisms** • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. **HS-LS2B.1: Cycles of Matter and Energy Transfer in Ecosystems** • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. **HS-LS2B.2: Cycles of Matter and Energy Transfer in Ecosystems** • Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter	only moves between one place and another place, between objects and/or fields, or between systems. • Energy drives the cycling of matter within and between systems. **Structure and Function** • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

	consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. **HS-LS2B.3: Cycles of Matter and Energy Transfer in Ecosystems** • Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. **HS-PS3.D: Energy in Chemical Processes** • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. **HS ESS2.D Earth's Systems: Weather and Climate** • Changes in the atmosphere due to human activity have increased carbon dioxide	

	concentrations and thus affect climate. • Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. • Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **HS ESS3: Earth and Human Activity** • Resource availability has guided the development of human society.	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively. (HS -LS3-2), (HS-LS3-3)
- MP.4 Model with mathematics.
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HSLS2-1), (HS-LS2-2), (HS-LS2-4)
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-1), (HS-LS2-2), (HS-LS2-4)
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

ELA

- Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
- Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-LS1-3)
- Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-7)
- Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-3)
- Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS2-3)

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Computer Science and Design Thinking

- 8.2.12.ETW.3 Identify a complex, global environmental or climate change issue, develop a systematic plan of investigation, and propose an innovative sustainable solution.

Career Readiness, Life Literacies, and Key Skills

- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.
- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems.

Social-Emotional Learning Competencies

- **Self Awareness:** Recognize one's feelings and thoughts.
- **Self Management:** Understand and practice strategies for managing one's own emotions, thoughts, and behaviors.
- **Responsible Decision-Making:** Develop, implement, and model effective problem-solving and critical thinking skills.
- **Social Awareness:** Demonstrate an awareness of the differences among individuals, groups, and others' cultures.
- **Relationship Skills:** Establish and maintain healthy relationships, utilize positive communication and social skills to interact effectively with others.

Learning Targets	Investigations/Resources	Formative Assessment
Investigate various plant structures related to optimal functioning/photosynthesis: leaves with pigments and stomata, roots and stems with capillary action.	Chromatography of Pigments in Spinach Leaves Stomata Investigation POGIL- What's in a Leaf? Gizmos and Stem Cases Honors (Spectrophotometer)	Responses to POGIL key concepts Student understanding demonstrated in short answer responses to STEM case summary questions.
Model the movement of atoms during the chemical reactions of photosynthesis and cellular respiration.	Science Take Out Pop-it Bead activity and analysis. Teacher created Card Sorts	Progress demonstrated in Exit ticket responses.
Compare the growth of normal green corn plants vs. albino corn plants and analyzing growth rate.	Albino Corn investigation	Summative: Construct an explanation to explain the different growth rates in albino and non-albino corn using student collected data.

Analyze various food webs and energy pyramids to explain the flow of energy and cycling of matter in an ecosystem.	POGIL- Ecological Pyramids Take a Virtual Dive in a Kelp Creating an imaginary ecosystem	Progress demonstrated in POGIL key concept responses. Accuracy demonstrated in Trophic Level Calculations.
Compare the processes of anaerobic and aerobic respiration.	Yeast Lab Honors: Fish Respiration Rates Lab	Anaerobic Cellular Respiration Task/Lactic Acid Fermentation Investigation Explanations
Evaluate the relationship between the processes of cellular respiration and photosynthesis.	POGIL: Photosynthesis and Respiration Science Take Out Pop-it Bead activity and analysis.	Progress demonstrated in POGIL key concept responses.
Model the movement of carbon in relationship to the processes of photosynthesis and cellular respiration and predict its impact on climate change.	POGIL: Carbon Cycle Video: How Humans Disrupted a Cycle Essential to All Life	Progress demonstrated in POGIL key concept responses. Progress demonstrated in Exit ticket responses. Ability to construct and use models to accurately explain the pathways carbon atoms use to cycle in the environment.

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this:

- Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Photosynthesis Assessment • Ecology Assessment	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

Hillsborough Township Public Schools
Biology CP/H Curriculum

Unit Title	**Time Frame/Pacing**
DNA Structure and Processes	45 Days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Anchoring Phenomenon:
Why do some people in the US have sickle cell/cystic fibrosis/etc. while most do not? (use current CDC/NIH data)

DNA Structure and Replication-
Phenomena:
- Images of different species- Why is one species different from another?

Essential Question:
- How is the genetic code preserved and passed on from generation to generation?

Cell Cycle and Mitosis
Phenomena:
- Cancer in the population (NIH Faces of Cancer Case Studies and Activity) Injuries in teen athletes and how do they heal?

Essential Question:
- How does the cell cycle regulate normal and abnormal cell growth?

Protein Synthesis
Phenomena:
- Why do some people in the US have sickle cell/cystic fibrosis/etc. while most do not? (use current CDC/NIH data)

Essential Question:
- How do DNA and RNA participate in the process of making proteins?

Honors: Hox Genes in Fruit Flies (video)

Enduring Understandings

- All cells contain DNA.
- DNA contains regions called genes which code for proteins.
- Groups of specialized cells (tissues) use proteins to carry out functions that are essential to the organism.

- Cells have the ability to divide and differentiate and are regulated by the cell cycle.
- Disruption in the cell cycle can lead to abnormal cell division.
- Mutations in the genetic code can alter protein structure and therefore organism functioning.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- 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.
- HS-LS1-6 Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- 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.

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Develop and Use Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. **Construction Explanations** • Construct 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	**LS1.A: Structure and Function:** • Systems of specialized cells within organisms help them perform the essential functions of life. • 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. **LS1.B: Growth and Development of Organisms** • In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to	**Structure and Function** • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. **Systems and System Models** • Models (e.g., physical,mathematical, computer models) can be used to simulate systems and interactions — including energy, matter, and information flows —

they did in the past and will continue to do so in the future. **Asking questions** • Ask questions that arise from examining models or a theory to clarify relationships.	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 complex organism,composed of systems of tissues and organs that work together to meet the needs of the whole organism. **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 (such as proteins or DNA), used for example to form new cells. **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	within and between systems at different scales. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

	regulatory or structural functions, and some have no as-yet known function.	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively. (HS-LS3-2), (HS-LS3-3)

ELA

- RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-LS3-1)
- WHST.9-12.1 Write arguments focused on discipline-specific content. (HS-LS3-2)

Computer Science and Design Thinking

- 9.4.5.CI.3 Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity.
- 9.4.5.CT.1 Identify and gather relevant data that will aid in the problem-solving process.
- 9.4.5.CT.4 Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global.
- 9.4.5.IML.2 Create a visual representation to organize information about a problem or issue .
- 9.4.8.CT.1 Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective.

Career Readiness, Life Literacies, and Key Skills

- 8.2.5.ED.2 Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
- 8.2.5.WITH.1 Explain how societal needs and wants influence the development and function of a product and a system.

Social-Emotional Learning Competencies

- **Social Awareness**: Demonstrate an awareness of the differences among individuals, groups, and others' cultures.
- **Relationship Skills**: Establish and maintain healthy relationships, Utilize positive communication and social skills to interact effectively with others.

Learning Targets	Investigations/Resources	Formative Assessment
Analyze how and why new cells are created during the cell cycle and mitosis.	Investigating the Limits of Cell Growth (agar cube activity)	Progress demonstrated in POGIL key concept responses.

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	POGILS- Cell Cycle and Mitosis Microscopy of Cell Division	Ability to construct and use models to explain the process of cell division in maintaining structure in an organism. Progress demonstrated in Exit ticket responses.
Analyze how cell differentiation allows for complexity in multicellular organisms.	Learn Genetics Stem Cell and Differentiation Modules	Progress on big idea stem cell activity responses. Progress demonstrated in Exit ticket responses.
Comparing and contrasting "normal" cell division with "abnormal" division to determine the effect on functioning in an organism.	Decoding Cancer Module NSTA How are cancer cells different from normal cells? Tufts Great Diseases Lesson Plans Lab: Normal & Abnormal Cell Division: Which of These Patients Could Have Cancer?	Progress demonstrated during completion of Lab 4 lab analysis worksheet. Summative: Developing an argument using evidence from Lab 4 activity.
Compare and contrast DNA sequence/cells from different types of organisms to determine what makes one species different from another.	Lab: DNA extraction PBS Freak Genomics DNA Sequencing Fact Sheet Comparing Chimp, Bonobo, and Human DNA	Progress demonstrated in Exit ticket responses. Progress demonstrated in Lab analysis responses.
Analyze the structure of DNA and how its code will affect the structure of the protein built.	Construction of 2D and 3D models of DNA POGIL: DNA Structure and Replication RNA and Protein Synthesis Gizmo	Progress demonstrated in POGIL key concept responses. Ability to construct and use models to explain how the structure of DNA/RNA allows the molecules to carry out their functions in living cells.

Analyze the effect a mutation in DNA has on the structure of the protein that it creates and how the new protein structure affects the functioning of the organism it is part of.	POGIL: Genetic Mutations Mutation Analysis Activities Cystic Fibrosis/Sickle Cell Sequence Analysis Activity and Explanation Construction	Progress demonstrated in POGIL key concept responses. Progress demonstrated in DNA mutation analysis activities. Progress demonstrated in explanation peer reviews and revisions. Summative- Constructing an explanation using evidence to explain the effects of a mutation on protein structure and organism functioning.

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this:

- Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Cell Growth and Division Assessment • DNA Assessment	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

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Unit Title	**Time Frame/Pacing**
Inheritance & Variation of Traits	35 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:

- Class baby picture identification (have students bring in baby pictures and create a slideshow to identify who it is)
- Famous family with a distinctive trait - how does this occur?
- Why are there more boys with color-blindness than girls?
- Mutations: Hemingway's Polydactyl Cats
- Random fluctuations give rise to odd genetic phenomenon

Essential Questions:

- What causes variations in individuals within a population?
- How are traits distributed within a population?
- How are traits passed from one generation to the next?

Enduring Understandings

- Chromosomes are made up of long strands of supercoiled DNA. Genes are segments of these DNA strands and found on the chromosomes.
- DNA codes for proteins which regulate the expression of traits in an organism. Environmental factors can also affect the expression of traits.
- Variations in genetic material naturally result during meiosis when corresponding sections of chromosome pairs exchange places (crossing-over).
- Genetic mutations can occur through errors in DNA replication or environmental factors.
- Genetic material is inheritable.

NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- 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.
- 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.
- HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

3-Dimensional Learning Components

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Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Asking Questions and Defining Problems • Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1) **Analyzing and Interpreting Data** • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS -LS3-3) • Engaging in Argument from Evidence Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (HS-LS3-2) • Using Mathematics and Computational Thinking In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. **Constructing Explanations and Designing Solutions** • Construct an explanation based on valid and reliable evidence obtained from a	**LS1.A : Structure and Function** • 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. (secondary to HS-LS3-1) **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 or structural functions, and some have no as-yet known function. (HS-LS3-1) **LS3.B: Variation of Traits** • In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations 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. Environmental factors can also cause mutations in genes, and	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1), (HS-LS3-2) **Scale, Proportion, and Quantity** • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth v s. exponential growth). (HS LS3-3) **Connections to Nature of Science Science is a Human Endeavor** • Technological advances have influenced the progress of science and science has influenced advances in technology. (HSLS3-3) Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

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.	viable mutations are inherited. (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)	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively. (HS -LS3-2), (HS-LS3-3)

ELA

- RST .11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS3-1), (HS-LS3-2)
- RST .11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-LS3-1)
- WHST .9-12.1 Write arguments focused on discipline-specific content. (HS-LS3-2)

Computer Science and Design Thinking

- 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
- 8.2.12.D.6 Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society.

Career Readiness, Life Literacies, and Key Skills

- 9.4.12.CI.1 Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12 prof.CR3a).
- 9.4.12.CI.2 Identify career pathways that highlight personal talents, skills, and abilities (e.g1.4.12 prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3 Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- 9.4.12.CT.2 Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.12.DC.7 Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).
- 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)
- 9.4.12.IML.4 Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).

- 9.4.12.TL.2 Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Social-Emotional Learning Competencies

- **Self Awareness:** Recognize one's feelings and thoughts
- **Self Management:** Understand and practice strategies for managing one's own emotions, thoughts, and behaviors
- **Responsible Decision-Making:** Develop, implement, and model effective problem-solving and critical thinking skills
- **Social Awareness:** Demonstrate an awareness of the differences among individuals, groups, and others' cultures
- **Relationship Skills:** Establish and maintain healthy relationships, utilize positive communication and social skills to interact effectively with others

Learning Targets	Investigations/Resources	Formative Assessment
• Investigate patterns of inheritance that allow us to predict the outcome of genetic crosses between various organisms.	• Analysis for patterns in data collected during Medel's experiments • Activities in which students set up and solve problems with monohybrid crosses, dihybrid crosses, incomplete dominance and codominance. • POGIL: Genetic Inheritance • Genetics in Harry Potter's World: • Honors: Drosophila Inheritance of Traits Lab • Honors: Lab 21: Models of Inheritance: Which Model of Inheritance Best Explains How a Specific Trait Is Inherited in Fruit Flies? (This lab can also be found in the book "Argument-Driven Inquiry in Biology" - NSTA Press) Design organisms with unique traits to model mating. Statistically analyze offspring to determine inheritance patterns. Communicate discovered inheritance pattern with class and revise model if necessary. (HS-LS3-3)	Various assessments throughout the unit to evaluate student understanding of what causes genetic variation in a population (over time these assessments should analyze the students understanding that new gene combinations result from meiosis, errors occur during replication, and environmental factors play a role. Progress on whiteboard or exit ticket responses that monitor understanding of analyzing a situation by creating and analyzing various Punnett Squares. Progress demonstrated in POGIL key concept responses.

• Apply knowledge of gene expression and heredity to the understanding of human genetic disorders.	Basic Ideas in Genetics Inquiry Hub- Bend 1- How Can Science Help to Make Our Lives Better	Have students construct an explanation that explains the impact of the various chromosomal disorders on the individual who inherits them. Progress demonstrated in POGIL key concept responses
• Use the tools of genetics, including punnett squares, karyotypes and family pedigrees, to predict the likelihood of a certain trait or disease being passed on from parent to offspring.	Karyotyping lab activity Analyzing pedigree activity Punnett square analysis for sex-linked traits, dominant/recessive autosomal disorders, and multiple alleles. Blood typing lab activity Gizmos/ Stem Cases	Progress demonstrated in Exit ticket responses Progress demonstrated in Lab analysis responses
• Investigate how mutations and sexual reproduction can produce genetic variation in an organism and therefore a species.	Pop-it modeling activities to explore the process of meiosis. Meiosis POGIL	Student-created models that allow students to accurately analyze/explain the process of meiosis and crossing over. Progress demonstrated in POGIL key concept responses.

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate

Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this:

- Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**

• Punnett Square Assessment	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.

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Unit Title	**Time Frame/Pacing**
Natural Selection, Evolution and Biodiversity	20 days

Phenomena/Anchoring Activity/Anchoring Question/Essential Questions

Phenomena:

- Homologous structures and embryo comparisons across different species- Why are they similar or different?
- Peppered moths
- Darwin finches
- Antibiotic resistance
- Silent Crickets

Essential Questions:

- How can we use available evidence to trace evolution over time?
- How do evolution and natural selection explain the diversity of species found on Earth?
- How does genetic variation lead to changes in a population over time and species diversity?
- How is human activity impacting biodiversity of ecosystems?

Enduring Understandings

- Evidence for evolution can be found in comparisons of DNA sequences, the fossil record, anatomical and embryological evidence.
- Genetic variation can lead to a variation of expressed traits in individuals in a population.
- Competition for limited resources causes individuals with traits that give a competitive advantage to be able to survive and reproduce at higher rates.
- Genes for traits with competitive advantage will be passed on in greater proportions to the next generation. Over many generations, groups with these traits can evolve into a different species.
- Natural selection relies on variation in genetic information and expression of traits.
- Natural selection causes adaptations that lead to changes in the distribution of traits within a population as conditions change.
- Changes in the environment, either natural or human induced, lead to changes in species such as growth, decline, emergence of new species or extinction.
- Humans depend on the resources and other benefits provided by biodiversity.
- Human activity is having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, invasive species and climate change.

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NJ Standards/NGSS Performance Expectations Taught and Assessed
Students who demonstrate understanding can:

- HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- 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.
- HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- 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.
- HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

3-Dimensional Learning Components

Science and Engineering Practices	Disciplinary Core Ideas (DCI)	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information • Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). **Constructing Explanations and Designing Solutions**	**HS ESS2.E Biogeology** • The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. **LS4.A: Evidence of Common Ancestry and Diversity** • Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. **Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Stability and Change**

• Construct 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. • Create or revise a simulation of a phenomenon, designed device, process, or system. **Using Mathematical and Computational Thinking** • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. **Engaging in Argument From Evidence** • Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.	descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. **LS4.B: Natural Selection** • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals. • The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. **LS4.C: Adaptation** • Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3)competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. -Natural selection leads to adaptation, that	• Much of science deals with constructing explanations of how things change and how they remain stable.

	is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. • Adaptation also means that the distribution of traits in a population can change when conditions change. • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. • Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**	

	• Moreover, anthropogenic changes (induced by human activity) in the environment — including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change — can disrupt an ecosystem and threaten the survival of some species. **LS2.D Social Interactions and Group Behavior** • Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. **LS4.D: Biodiversity and Humans** • Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). • Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.	

	ESS3.C Human Impact on Earth Systems • The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.	

Interdisciplinary Connections: Math, ELA, and Computer Science and Design Thinking

Math

- MP.2 Reason abstractly and quantitatively. (HS-LS4-1), (HS-LS4-3), (HS-LS4-4), (HS-LS4-5)

ELA

- RST-11.12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS4-1), (HS-LS4-2), (HS-LS4-3), (HS-LS4-4)
- RST-11.12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS4-5)
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS4-1), (HS-LS4-2), (HS-LS4-3), (HS-LS4-4)
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-1), (HS-LS4-2), (HS-LS4-3), (HS-LS4-4), (HS-LS4-5)
- SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS-LS4-1), (HS-LS4-2)
- WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS4-6), (HS-LS2-7)
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS4-6), (HS-LS2-7)

Computer Science and Design Thinking

- 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
- • 8.2.12.ITH.3 Analyze the impact that globalization, social media, and access to open source technologies has had on innovation and on a society's economy, politics, and culture.

Career Readiness, Life Literacies, and Key Skills

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST-SM.3 Analyze the impact that science and mathematics has on society.
- 9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems.

Social-Emotional Learning Competencies

- **Responsible Decision-Making:** Develop, implement, and model effective problem-solving and critical thinking skills;
- **Relationship Skills:** Utilize positive communication and social skills to interact effectively with others.

Learning Targets	Investigations/Resources	Formative Assessment
Conduct investigations to explain how variations within a species can lead to natural selection and speciation based on advantageous traits.	Nature Biodiversity Video Natural Selection Simulation Bird Beak Island Investigation Natural Selection PhET -analyze adaptations in a rabbit population by varying different environmental factors. (see teacher resources) Frog Dissection Lab	Class analysis and interpretation of quantitative data from bird beak investigation. Progress demonstrated in Lab analysis responses. Progress demonstrated in POGIL key concept responses. Evolution and Selection POGIL: What mechanisms lead to changes in the diversity of species on Earth?
Analyze evidence of evolution to show connections between related species.	Embryo Image Guess the Embryo POGIL-Evidence for Evolution Barbellus comparative anatomy/evolutionary tree activity. Modified Investigation: Amino Acid Sequences and Evolutionary Sequences Storyline: Bend 1 (Addie) Evolution	Progress demonstrated on lab analysis responses. Exit ticket responses demonstrating accurate relationship inferences. Progress demonstrated in POGIL key concept responses.

Conduct an investigation to explain the impact of human activities on the biodiversity of an ecosystem.	Pre-Investigation and Investigation where students have the opportunity to investigate an area's biodiversity and then calculate the biodiversity index. The use of the biodiversity index calculation to explain the health of the area.	Progress demonstrated on lab analysis responses.

Instructional Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate
Individual accommodations and modifications in students' IEP and 504's will be followed and adhered to. Along with this: • Group work and projects in this unit will be designed to allow the struggling learners to scaffold their learning and develop skills for working on larger projects by breaking down tasks. All students will be given opportunities to use different learning modalities to advance their understanding using varied strategies that accentuate their own learning style. Gifted learners will have the opportunity to challenge their problem solving skills by asking more complex questions and exploring concepts in greater depth.

Common Assessment(s)	**Assessment Modifications and/or Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504) When Appropriate**
• Evolution Assessment	• All assessments will be modified in accordance with specifications from CST as enumerated in each student's educational plan. This may include, but is not limited to, extra time, clarification of questions, reading questions aloud, word banks, and alternate testing sites.