



SPRINGFIELD PUBLIC SCHOOLS
ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

Springfield Public Schools
Springfield, New Jersey 07081

Biology
Grade 9

Curriculum Guide

2026

This curriculum may be modified through varying materials, techniques, and strategies as per an individual student's IEP.

Springfield Board of Education
Approved July 27, 2026



**Springfield Public Schools
Springfield, New Jersey**

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Superintendent of Schools**

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Springfield Public Schools

Cultivating compassionate and extraordinary learners!

EXTRACT OF THE MINUTES OF A MEETING OF
THE BOARD OF EDUCATION OF
THE TOWNSHIP OF SPRINGFIELD
COUNTY OF UNION, NEW JERSEY
AS RECORDED IN THE OFFICIAL MINUTE BOOK

Resolution: 21

Introduced By: Mrs. Gamarekian

Seconded By: Vice President Rinaldi

Adopted: July 27, 2026

Curriculum Adoption

To approve the following new and revised curriculum and courses for the 2026-2027 school year:

1. High School Courses

- a. AP Cybersecurity (new course)
- b. AP Business with Personal Finance (new course)
- c. AP Biology
- d. AP Chemistry
- e. AP Physics I
- f. PLTW Robotics and Automation
- g. PLTW Introduction to Engineering Design
- h. PLTW Principles of Engineering
- i. Biology
- j. Biology Honors
- k. Chemistry
- l. Chemistry Honors
- m. Conceptual Physics
- n. Physics
- o. Environmental Science
- p. Forensics
- q. Human Anatomy and Physiology
- r. Oceanography
- s. Science 8
- t. Molecular Biology Research Lab (new course)

2. Middle School Courses

- a. Science 6
- b. Science 7

3. Elementary School Courses

- a. Kindergarten Science
- b. Grade 1 Science
- c. Grade 2 Science

Michelle Calas, School Business Administrator/Board Secretary

(continued)

I, Michelle Calas, School Business Administrator/ Board Secretary of the Springfield Board of Education, hereby certify that the extract from the minutes of a meeting of the Board of Education duly called and held on July 27, 2026 has been compared by me with the original minute book of said Board of Education, and is a true, complete and exact copy thereof, as far as the same relates to the subject matter to on said extract.

In WITNESS THEREOF, I have hereunto set my hand and seal of the Springfield Board of Education, this 28th day of July 2026.

SEAL



Michelle Calas
School Business Administrator/ Board Secretary



Introduction

This template is the product of an initiative led by the New Jersey Department of Education, Office of Academic Standards, in partnership with the New Jersey Association for Supervision and Curriculum Development (NJASCD) and the New Jersey Principals and Supervisors Association (NJPSA). The project was undertaken with the assistance of New Jersey content area supervisors, curriculum coordinators, and teachers during spring-summer 2009. The goal of the project was to design exemplary unit plans and accompanying lesson plans aligned with the New Jersey Student Learning Standards that may be used by districts as models for the development of local curricula.

The Unit Overview Template, which follows, is a tool that can help districts define one unit plan of several that comprise a specific course in the curriculum for any content area. It is designed, once completed, to summarize the content and objectives for the unit, outline lessons and assessments that support the unit, and provide links to documents that facilitate delivery of the unit, such as student materials, background information, resources, and performance rubrics. To see how the units fit together in the design of a course, see the Curriculum Design Template included at the end of this document.

Seven content area Unit Overviews were created as part of the project to serve as exemplar unit plans that are aligned with the New Jersey Student Learning Standards and that assist in achieving the goal of engaging students, fostering achievement, and cultivating 21st century global skills. The units stress the integration of 21st century themes and skills, global perspectives, technology, and cross-curricular connections.

We encourage districts to use the examples in conjunction with the curriculum development tools and templates that emanated from this project as models for teaching and learning based on the New Jersey Student Learning Standards.



Unit Overview Template

Content Area: Biology **Grade Level:** 9 **Unit Title:** Structure and Function, Energy, Cell Specialization and Homeostasis

Unit Summary: In this unit of study, students formulate the answer to the question “How do the structures of organisms enable life’s functions?” 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 apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration.

Primary Interdisciplinary Connections: Genetics

21st Century Themes ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ ICT Literacy
☐ Information Literacy ☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: Students will analyze and interpret data, use mathematical and computational thinking, and construct explanations as they demonstrate understanding of the interrelationship between structure and function that leads to homeostasis of cells and organisms.

Career Readiness, Life Literacies, and Key Skill (Standard 9):

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
- 9.4.12.CT.4: Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.

Learning Targets

Standards: HS-LS1

Content Statements: From Molecules to Organisms: Structures and Processes

CPI#:	Cumulative Progress Indicator (CPI):
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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-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
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-LS1-7	Use a model to illustrate that cellular respiration is a chemical process whereby the bond of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
8.2.12.ED.1	Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.4	Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

Science and Engineering Practices:

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)
- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4), (HS-LS1-5), (HS-LS1-7)

Planning and Carrying Out Investigations

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

- 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 the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)



Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct 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. (HS-LS1-1)
- 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. (HS-LS1-6)

Disciplinary Core Ideas (DCIs):

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)
- 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. (HS-LS1-2)
- 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 encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

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 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. (HS-LS1-4)

LS1.C: 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-LS1-5)
- 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. (HS-LS1-6)

- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6), (HS-LS1-7)
- 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-LS1-7)

Crosscutting Concepts:

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 scales. (HS-LS1-2), (HS-LS1-4)

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. (HS-LS1-5), (HS-LS1-6)
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS1-7)

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. (HS-LS1-1)

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. (HS-LS1-3)

Unit Essential Questions:

- How do we build and refine models that describe and explain the natural and designed world?
- How is scientific knowledge constructed?



- What is the basic structure of the atom and how is it related to cellular processes?
- How is matter transferred, and how is energy transferred and transformed in living systems?
- How is conservation of matter represented in biochemical processes?
- What is the effect on the rate of reactions when conditions are varied?
- How are food molecules built and broken down by cells?
- How does structure relate to function in living systems from the organism to the cellular level?

Unit Enduring Understandings:

- Cells are the basic unit of life.
- There are levels of organization at the cellular level among prokaryotes and eukaryotes.
- Cells are specialized to carry out different functions.
- Subcellular structures are specialized organelles that carry out different functions to increase efficiency.
- Organisms regulate homeostasis using negative and positive feedback systems.
- Cells and organisms regulate concentration of internal water and solutes.
- DNA codes for the formation of proteins that function in a variety of ways to maintain homeostasis.
- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.
- 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.
- The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.

Unit Learning Targets:

Students will....

- Develop a model that will explain how the fundamental life processes of organisms depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.
- Model how cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings, including the transport of materials into and out of the cell.
- Develop a model that will explain how the many cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions.
- Trace the general process where the progeny from a single cell form an embryo in which the cells multiply and differentiate to form the many specialized cells, tissues and organs that comprise the final organism.
- Present evidence that supports the concept that complex multicellular organisms are formed as a highly organized arrangement of differentiated cells.
- Providing examples of how photosynthesis and cellular respiration are related and necessary to maintain homeostasis and provide energy.



Evidence of Learning

Summative Assessment: Unit Assessment and Labs

Equipment Needed: Student iPads, laboratory materials and supplies, safety equipment, measuring tools, calculators

Teacher Resources: Teacher laptop, textbook, laboratory materials and supplies, safety equipment, measuring tools, calculators

Formative Assessments:

- Quizzes
- Assignments
- Activities
- Labs
- Project



Lesson Plans

Lesson	Time Frame
Lesson 1 The Mitosis Cinema – Stop-Motion Biogenesis	2 days
Lesson 2 Seed Germination	3 days
Lesson 3 The "Cell-ection"	3 days

Teacher Notes: Students should have knowledge of the steps of mitosis and cell metabolism. Basic concepts of the inputs and outputs of photosynthesis should be part of the students' understanding before beginning this unit section.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

- https://youtu.be/sQK3Yr4Sc_k
- <https://youtu.be/Lok-enzoeOM>



Lesson Plan 1 Template

Content Area: Biology Lesson Title: The Mitosis Cinema – Stop-Motion Biogenesis Time Frame: 2 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☐ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Student iPads for accessing instructional resources and iMovie
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Produce a stop-motion simulation of mitosis to model the mechanical movements of chromosomes. - Demonstrate spatial understanding of how one parent cell creates	Lesson Sequence Anchoring Phenomenon: A cut on your finger heals in just a few days, producing millions of new cells that are genetically identical to the original cells. How can one cell repeatedly divide to create so many	The "Checkpoint" Challenge: Before moving from Metaphase to Anaphase in their film, the teacher must "clear" them. Students must explain how the cell "knows" all chromosomes



two identical daughter cells. Identify phases of the cell cycle in real-world samples (onion root tips or whitefish blastula).	perfectly copied replacements, and what happens if the process goes wrong? 2. Tactile Exploration (The "CSI" Hook): Group students in threes. Provide "Mystery Micro-Slides." Their mission: Find a cell "caught in the act" of dividing. They must sketch it and identify if the DNA is "loose" (interphase) or "packed for travel" (prophase). 3. The Production Meeting: Groups assign roles: Director (Oversees accuracy), Lead Animator (Moves the models), and Script Writer (Explains the biology). - The Biological Key: Students must define their materials (e.g., Pipe cleaners = Sister Chromatids; String = Spindle Fibers; Bead = Centromere). 4. Kinesthetic "Dry Run": Before filming, students must perform a "Silent Film" version on their desks. They physically move the pipe cleaners. The teacher acts as the "Quality Control Inspector," checking that the sister chromatids separate correctly during Anaphase.	are attached to the middle. Peer-to-Peer Review: Groups swap iPads and watch a draft of the animation. The "Reviewing Group" must find one "mechanical error" (e.g., "The nuclear envelope didn't disappear!") before the final edit.
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5. Stop-Motion Production:
Using iPad apps like iMovie, students take a photo, move the "chromosomes" 1 centimeter, and repeat.
 - Modern Twist:
They must include a "Mutation Scene" where a spindle fiber breaks—they must then explain the consequence (Non-disjunction).
6. Digital Integration:
Students add a voice-over. They shouldn't just say "This is Metaphase"; they should say, "The chromosomes are lining up at the equator to ensure an even split of the genetic blueprints."

Differentiation:

Kinesthetic Support Group: A teacher-led group will utilize a prefabricated mitosis model kit to ensure structural accuracy.

Tactile Scaffolding: Use a labeled table of parts as a "map" for the kit. Students in this group will take photos of the pre-made models and focus on the labeling and voice-over narration to demonstrate knowledge.

Direct Support: Teacher support is provided for the technical transition of images from camera to laptop

Resources Provided:

- <https://youtu.be/Lok-enzoeOM>
- https://youtu.be/_ppedXZHhEo



Lesson Plan 2 Template

Content Area: Biology Lesson Title: Seed Germination Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Plastic ziploc bag
 Paper towel or large cotton balls
 Seed (radish seeds)
 Spray bottle with water
 Light source with LED colored light changing capacity.
 Dark cabinet

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Construct a living observation system to monitor seed germination and early root development. - Perform comparative measurements to analyze how specific light variables (Natural, Dark, or Green LED) impact growth rates.	Lesson Sequence: Anchoring Phenomenon: Seeds that have remained dry and seemingly lifeless for years can suddenly sprout roots and leaves within days after receiving water. How can something that appears dormant suddenly become a rapidly growing living organism?	- The "Variable Flip": Students must create a physical "New Experiment" card involving the same materials but a different variable. They will present this to the class using a "pitch" format. - Visual Data Mapping: Students must translate their raw measurements



• Model cellular division by documenting physical changes in seed anatomy, proving that growth occurs through division rather than photosynthesis alone	2. Tactile Prediction (The Hook): Group students in threes. Give each group dry radish seeds and "pre-soaked" seeds. Have them use a magnifying glass or microscope to feel and see the difference, predicting what physical changes happen first. 3. Collaborative Planning: Groups hold a "Design Meeting" to assign roles (Lead Botanist, Data Recorder, Systems Engineer) and finalize their experimental design. 4. System Construction: Students manually assemble their germination bags. They must "sculpt" the cotton balls or paper towels to create a stable environment, place four seeds precisely at the bottom, and apply a measured spray of water. 5. The Variable Setup: Groups physically place their systems in one of three "Climate Zones": Window (Natural), Cabinet (Dark), or Green LED station. 6. Active Data Collection: After 48 hours, students perform "Live Inspections". Instead of just observing, they will measure root length using string or calipers to	into a physical graph or chart (student choice of format) to visually demonstrate growth trends to their peers.
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- get tactile, accurate data for their charts.
7. Inquiry Expansion: Students physically sketch the cell-level changes they see under the microscope and then design a "Variable Pivot" experiment to test a new physical factor like temperature or moisture.

Differentiation:

Collaborative Support: Students with an IEP are paired in groups with strong writing leads or teacher-facilitated teams.

Conceptual Anchors: Provide "Concept Keys" or tactile notes about cell division for easy physical reference during the lab.

Motor Skill Modification: Provide "Ready-Set Bags" (prefabricated setups) for students with motor skill issues to ensure they can focus on the observation and data stages

Resources Provided:

Video Tutorials:

- <https://youtu.be/rbjXZZsLfVo>
- <https://youtu.be/UcTl9S9koxU>
- <https://youtu.be/7q8acfBxSto>
- <https://youtu.be/aLesk8fujH8>



Lesson Plan 3 Template

Content Area: Biology Lesson Title: The "Cell-ection" Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Microscopes

Student iPads for accessing instructional resources, simulations, and scientific databases

Digital data collection and analysis tools for organizing and interpreting experimental results

Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations

Multimedia resources, videos, and interactive models to support biological concepts

Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads

Laboratory materials and supplies appropriate to the investigation

Safety equipment (goggles, gloves, aprons as needed)

Measuring tools and laboratory equipment

Calculators

Data collection sheets or laboratory notebooks

Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Construct an explanation for how specific organelles (The Candidates) maintain homeostasis and support the life of the cell. - Analyze the relationship between energy-processing organelles	Lesson Sequence Anchoring Phenomenon: Certain genetic diseases can be traced to the failure of a single organelle, even though all of the organelles work together in the same cell. How can one tiny structure malfunction and cause an entire	- Energy Flow: Use the Mitochondria vs. Chloroplast debate to reinforce the relationship between Photosynthesis and Cellular Respiration. - Protein Synthesis: Use the Ribosome/ER/Golgi candidates to demonstrate the



(Chloroplasts/Mitochondria) and protein-building organelles (Ribosomes/ER). • Create a model (Campaign Poster) that illustrates the "Molecular Platform" of their candidate (e.g., ATP production or Protein Synthesis).	cell—or even an entire organism—to become sick? 2. Group students in groups of three. 3. Groups choose their "Presidential Candidate." Options include: The Nucleus, The Mitochondria, The Chloroplast, The Ribosome, The Cell Membrane, or The Lysosome. 4. Planning Meeting: Students assign roles: ○ Campaign Manager (Researcher) ○ Press Secretary (Graphic/Poster Designer) ○ The Candidate (Debater) 5. Research Phase: Students must research their candidate's "Platform": ○ What is their "Job"? (Main function). ○ What molecules do they work with? (e.g., Mitochondria needs Glucose; Ribosomes need Amino Acids). ○ Opponent Research: They must find "disparaging information" (malfunctions/diseases) about other candidates. (e.g.,	"Endomembrane System" and how large carbon-based molecules (proteins) are shipped out of the cell. • Disease Link: Apply this to real-world biology by having students research "Organelle Failure" (e.g., Mitochondrial disease or Tay-Sachs for Lysosomes).
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	"If the Lysosome fails, the cell turns into a literal trash heap!"). 6. Campaign Development: Groups create a campaign poster using digital tools or paper. ○ The Visual: Must include a diagram of the organelle's structure and its "Product" (e.g., a drawing of ATP or a Protein chain). ○ The Slogan: Must be catchy and biological (e.g., "Nucleus: Because a Cell Without a Brain is a Cell Without a Future!"). 7. Submission: Collect posters and "Debate Prep" worksheets. 8. The Great Cell Debate: Hold a "Town Hall" moderated by the teacher. ○ Question 1: "The cell is running low on energy. Why are YOU the best candidate to fix this?" ○ Question 2: "A virus has just entered the cell membrane. How will your department protect us?"	
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Differentiation:

Students with an IEP should work in a group with strong writing skills or within a group with a teacher lead. They also may be grouped assessed using guided verbal feedback instead of using the challenge questions.

Resources Provided:

<https://youtu.be/H8WJ2KENlKo>

<https://youtu.be/YO244P1e9QM>

<http://molview.org/>



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson **Strongly, Moderately** or **Weakly** meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☐	☒	☐
Allow for student choice	☐	☒	☐
Provide scaffolding for acquiring targeted knowledge/skills	☐	☒	☐
Integrate global perspectives	☐	☐	☒
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☐	☒	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Biology **Grade Level:** 9 **Unit Title:** Structure and Function, Energy, Cell Specialization and Homeostasis

Created: 2026

Board Approved on:



Unit Overview Template

Content Area: Biology **Grade Level:** 9 **Unit Title:** Ecosystems: Interactions, Energy and Dynamics

Unit Summary: In this unit of study, students formulate answers to the question “how and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions?” Students construct explanations for the role of energy in 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 respirations. Students also understand organisms' interactions with each other and their physical environment and how organisms obtain resources. Secondary ideas include the interdependent relationships in ecosystems; dynamics of ecosystems; and functioning, resilience, and social interactions, including group behavior. Students examine factors that have influenced the distribution and development of human society: these factors include climate, natural resource availability, and natural disasters. Students analyze how earth systems are being modified by human activity. Students use mathematical reasoning and models to make sense of carrying capacity, factors affecting biodiversity and populations, the cycling of matter and flow of energy through systems. Students design, evaluate and refine solutions for reducing the impact of human activities on the environment and maintaining biodiversity. The crosscutting concepts of scale, proportion, and quantity and stability and change are organizing concepts for the disciplinary core ideas.

Primary Interdisciplinary Connections: Environmental Science

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ ICT Literacy
☐ Information Literacy ☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: Students will analyze and interpret data, use mathematical and computational thinking, and construct explanations as they demonstrate understanding of systems and the effect of human activity on the environment and maintaining biodiversity.

Career Readiness, Life Literacies, and Key Skill (Standard 9):

- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately.
- 9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas. 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.



- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition.
- 9.4.12.CT.3: Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue.
- 9.4.12.CT.4: Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.
- 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society.

Learning Targets

Standards: HS-LS2-1, HS-ETS-1, HS-ESS1, HS-ESS1

Content Statements: Ecosystems: Interactions, Energy, and Dynamics, Engineering Design, Earth's Place in the Universe

CPI#:	Cumulative Progress Indicator (CPI):
HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales
HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
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.
HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
HS-LS2-6	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS2-8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-ESS1-1	Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.



HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
HS-ETS1-1	Analyze a major global challenge to specify qualitative and qualitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2	Design a solution to complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including costs, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
Math.F-LE.A	Construct and compare linear and exponential models and solve problems.
8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.

Science and Engineering Practices:

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show how relationships among variables between systems and their components in the natural and designed worlds.

- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5)

Using Mathematics and Computational Thinking

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

- Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS-LS2-1)



- Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2)
- Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)

Asking Questions and Defining Problems

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1)

Using Mathematics and Computational Thinking

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

- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions 9–12 builds on K – experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

- Design a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)

Disciplinary Core Ideas (DCIs):

LS2.A: Interdependent Relationships in Ecosystems

- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1), (HS-LS2-2)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems



- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3)
- 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 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-LS2-4)
- 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-LS2-5)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2), (HS-LS2-6)
- 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. (HS-LS2-7)

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. (HS-LS2-8)

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)
- 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. (secondary to HS-LS2-7) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)

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. (secondary to HS-LS2-5)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (secondary to HS-LS2-7).

Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

ETS1.C: Optimizing the Design Solution

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HS-ETS1-2)

Crosscutting Concepts:

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8)

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-2), (HS-LS2-3)



- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (HS-LS2-6)

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 scales. (HS-ETS1-4)

Connections to Engineering, Technology, and Applications of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (HS-LS2-6), (HS-LS2-8)

Influence of Science, Engineering, and Technology on Society and the Natural World

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1), (HS-ETS1-3)

Unit Essential Questions:

- How and why do organisms interact with each other (biotic factors) and their environment (abiotic factors) and what affects these interactions?
- How is mathematics used to analyze changes in the ecosystem?
- How does matter cycle through an ecosystem?
- How does energy flow through an ecosystem?
- What are the effects of human activity on the biosphere?

Unit Enduring Understandings:

- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.
- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.
- 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 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.

- 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.
- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
- 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.
- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
- 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.
- 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.
- The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.
- When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.

Unit Learning Targets:

Students will....

- Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.



- Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
- Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
- Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
- Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.



Evidence of Learning

Summative Assessment: Unit Assessment and Labs

Equipment Needed: Student iPads, laboratory materials and supplies, safety equipment, measuring tools, calculators

Teacher Resources: Teacher laptop, textbook, laboratory materials and supplies, safety equipment, measuring tools, calculators

Formative Assessments:

- Quizzes
- Assignments
- Activities
- Labs
- Project



Lesson Plans

Lesson	Time Frame
Lesson 1 Ecosystem Under Investigation – Trophic Cascade News Reports	3 days
Lesson 2 The "Eco-Audit" – Habitat Investigative Reports	1 day
Lesson 3 The "Human Surge" – Global Population Investigative Reports	4 days

Teacher Notes: Students will work together in a cooperative learning environment. Teacher(s) are to give support and suggestions on the direction of the projects, but all work is based on pre-requisite knowledge with a few mini lessons for clarification. Resulting projects will be presented to the class and if desired students may work with Springfield's environmental clubs to showcase their work to the public.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

- <https://www.sciencedaily.com/releases/2020/09/200910150313.htm>
- https://youtu.be/E8dkWQVFAoA?list=PL8dPuuaLjXtNdTKZkV_GiIYXpV9w4WxbX (crash course video link)
- <http://www.worldometers.info/world-population/>
- <http://news.nationalgeographic.com/news/2014/09/140920-population-11billion-demographics-anthropocene/>



Lesson Plan 1 Template

Content Area: Biology
 News Reports

Lesson Title: Ecosystem Under Investigation – Trophic Cascade
 Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Environmental Science

Integration of Technology:

Microscopes

Student iPads for accessing instructional resources, simulations, and scientific databases

Digital data collection and analysis tools for organizing and interpreting experimental results

Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations

Multimedia resources, videos, and interactive models to support biological concepts

Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads

Laboratory materials and supplies appropriate to the investigation

Safety equipment (goggles, gloves, aprons as needed)

Measuring tools and laboratory equipment

Calculators

Data collection sheets or laboratory notebooks

Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Describe the relationships (predation, competition, and energy flow) among organisms within a specific ecosystem. - Analyze the "Top-Down" or	Lesson Sequence Anchoring Phenomenon: When wolves were reintroduced to Yellowstone National Park, populations of elk, beavers, vegetation, and even river channels changed dramatically. How can the return of one species	- The "Field Notes": Research worksheet documenting the food web links and sources. - The Evidence Board: A visual food web showing the "Missing" species and the resulting



"Bottom-Up" effects of losing a specific species. • Create a visual model (Food Web) to support their investigative journalism.	transform an entire ecosystem? 2. Individual/Pair Research: Students are assigned a "Missing Species" case file. They use a worksheet to document the species' Trophic Level, its Prey, its Predators, and its Niche within its specific ecosystem. 3. The "Crime Scene" Assignments: Divide the class into six "Expert Investigative Teams" focused on famous ecological disruptions: ○ The Yellowstone Case: The disappearance (and return) of the Gray Wolf. ○ The Kelp Forest Crisis: The loss of Sea Otters and the rise of "Urchin Barrens." ○ The African Savanna Mystery: The impact of Elephants as ecosystem engineers. ○ The Coral Reef Collapse: The decline of Reef Sharks and the impact on parrotfish. ○ The Mid-Atlantic Mystery: The overfishing of Menhaden and its effect on Ospreys/Striped Bass. ○ The Rainforest Ripple: The loss of Jaguars and the overpopulation of seed-eaters. 4. Expert Groups: Teams compare their individual	population shifts (arrows up/down). • The Final Broadcast: The live or filmed news report.
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- research. They must "connect the dots" by drawing a Food Web of their ecosystem and identifying where the "break" occurred. They then consolidate this into one TV News Investigative Script.
5. Assistance: Provide "Evidence Photos" (diagrams of energy pyramids or population graphs) to help groups resolve "areas of dissention" regarding which species increased or decreased.
 6. The Breaking News Broadcast: Groups present their findings as a "Special Report: Ecosystem in Crisis."
 - Example: "Live from the Pacific Coast: The Kelp Forests are vanishing! Our lead investigator reveals how the missing Sea Otter has left the Sea Urchins unchecked. Is this the end of the kelp?"
 7. Audience Interaction: After each report, the "studio audience" (the class) must ask one question about the Energy Flow (e.g., "If the producer population crashes, how does that affect the Tertiary consumers?").

Differentiation:

Students with an IEP can work in a group of 3 and research a given relationship, completing the worksheet. Additionally, a poster or a PowerPoint could be created instead of a news report. Or an IEP student could be paired with a student with strong writing skills to develop the news report.

Resources Provided:

- <http://schools.peelschools.org/sec/lornepark/SiteCollectionDocuments/EQAO/OSSLT%20StED-Writing%20A%20News%20Report.pdf>



SPRINGFIELD PUBLIC SCHOOLS
ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

- <https://owl.english.purdue.edu/owl/resource/735/05/>
- <https://youtu.be/JPHqUxxyLsY>
- <https://youtu.be/GxE1SSqbSn4>



Lesson Plan 2 Template

Content Area: Biology Lesson Title: The "Eco-Audit" – Habitat Investigative Reports
 Time Frame: 1 day

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Environmental Science

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Model the relationship among organisms using complex food webs rather than simple chains. - Trace the flow of energy (10% Rule) and the	Lesson Sequence Anchoring Phenomenon: The introduction of a single invasive species, such as the Spotted Lanternfly, can rapidly	The Eco-Map: A photographed or sketched version of their yarn-and-card food web.



cycling of matter (Carbon/Nitrogen). • Predict the impact of a disturbance (invasive species or pollution) on the ecosystem's stability.	disrupt local food webs and alter ecosystem stability. How can one new species create widespread changes throughout an entire habitat? 2. Group students in pairs of 2. Assign each pair a specific "Local Client" (e.g., A local pond, a backyard forest, or a nearby marsh). 3. The Resource Kit: Instead of a worksheet, give students a bag of "Species Cards" (organisms found in that habitat) and "Resource Tokens" (representing Sunlight, Water, and Nutrients). 4. The "Audit" Mapping: ○ Students must physically arrange their cards to create a Food Web. ○ They must use colored yarn to connect them: Red for energy flow (who eats whom) and Blue for nutrient cycling (who dies and decomposes). 5. The "Expert" Investigation: Divide the	• The "Audit Report": A script detailing the specific symbiotic relationships (Mutualism, Parasitism) discovered during the audit. • The Impact Prediction: A written "Forecast" on how the ecosystem will look in 10 years if the current disturbances continue.
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class into "Expert Bureaus" to deep-dive into the audit:

- The Productivity Desk: Calculate if there are enough Producers to support the Tertiary consumers (using the 10% rule).
- The Scavenger Squad: Report on how Decomposers are recycling "Large Carbon-Based Molecules" back into the soil.
- The Invasive Alert Team: Introduce a "Mystery Card" (an invasive species like a Spotted Lanternfly or Kudzu) and have students predict which native populations will crash.

6. The Breaking News Broadcast: Groups present their "Audit" as a Formal TV News Report.
- Example: "Live from the Oak Forest: We've discovered a major energy leak! With



	the decline of the fox population, the primary consumers are overgrazing the producers. Is the forest's carrying capacity at risk?" 7. The "Is over Of" Math Check: Use the percent math we practiced to have the audience calculate: "What is the energy available to the hawk of the original energy from the sun?"	
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Differentiation:

Students with an IEP can work in a teacher-supported group to create a large scaled graph (1 for the group). Students will work as a group to answer the questions. Instead of making predictions or researching factors that will influence human population growth, a series of videos will be shown to the students about these topics. As a group, the students will discuss the videos (teacher directed).

Resources Provided:

- <https://youtu.be/E8dkWQVFAoA>
- https://youtu.be/QAkW_iobDpQ
- <https://youtu.be/VcSX4ytEfcE>



Lesson Plan 3 Template

Content Area: Biology Lesson Title: The "Human Surge" – Global Population Investigative Reports
 Time Frame: 4 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Environmental Science

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Create a graph of human population growth (Historical to Present). - Predict future growth based on current trends and demographic transitions.	Lesson Sequence Anchoring Phenomenon: The human population required thousands of years to reach one billion people, but it increased from seven billion to eight billion in only eleven years. Why has	- The "Census Log": The completed graph of human population growth with labeled milestones (Industrial Revolution, etc.). - The "Trend Forecast": A written prediction of



Identify and report on specific factors (Medical, Agricultural, Industrial) that drive growth and the resulting impact on ecosystems.	human population growth accelerated so dramatically, and what challenges does this create for Earth's resources and ecosystems? 2. Individual/Pair Research (The Data Dive): Students are given a set of historical population data (from 10,000 BCE to 2026). They must create a line graph of the data. - Task: Identify the "J-Curve" (Exponential Growth) and mark the specific year the population hit 1 Billion (1804) versus 8 Billion (2022). 2. The "Regional Bureau" Assignments: Divide the class into six "Expert Investigative Teams," each representing a different region or factor affecting the "Human Surge": - The Medical Correspondents: Impact of vaccines, antibiotics, and sanitation on death rates. - The Green Revolution Reporters: Impact of industrial agriculture and synthetic	where the graph will go in the next 50 years (logistic vs. exponential). The Final Broadcast: The live or filmed news report.
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	fertilizers on carrying capacity. ○ The Urbanization Unit: Analysis of habitat fragmentation and "Heat Islands" as cities expand. ○ The Resource Rangers: Investigating the "Trash Paradox"—how population growth correlates with plastic pollution and landfill space. ○ The Biodiversity Desk: Reporting on the "Sixth Mass Extinction"—how human expansion leads to species loss (HIPPCO). ○ The Future Forecasters: Using current growth rates to predict the population in 2050 and 2100. 3. Expert Groups: Teams compare their graphs and research. They must "connect the dots" between their specific factor and the global J-Curve. They then consolidate this into one TV News Investigative Script. 4. Assistance: Provide "Population Pyramid" diagrams for different countries (e.g., Nigeria vs. Japan) to help groups	
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	understand why some populations are exploding while others are shrinking. 5. The Breaking News Broadcast: Groups present their findings as a "World Census Special Report."	
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Differentiation:

Students with an IEP can work in a group of 3. A teacher directed meeting will focus the students on a particular topic and guidance is given throughout the process to ensure that the students meet deadline(s) and any additional accommodations are granted. If necessary, students may be given additional class time or take the project home to work on designated sections. Furthermore, if necessary a PowerPoint presentation instead of a website could be created. If inclined, students could create a video of their work (Flipgrid) as opposed to a website or written product.

Resources Provided:

- <https://www.weebly.com/>
- <https://www.wix.com/>
- <https://youtu.be/5eTCZ9L834s>
- <https://youtu.be/sW7fxGG9cEM>
- <https://youtu.be/vgpbGjXRObE>



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson **Strongly, Moderately** or **Weakly** meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☒	☐	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☐	☒	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☐	☒	☐

Curriculum Design Template

Content Area: Biology	Grade Level: 9	Unit Title: Ecosystems: Interactions, Energy and Dynamics
Created: March 2026 Carla Kelly		Board Approved on:



Unit Overview Template

Content Area: Biology **Grade Level:** 9 **Unit Title:** Heredity

Unit Summary: In this unit of study 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 determine why individuals of the same species vary in how they look, function, and behave. Students develop conceptual models of the role of DNA in the unity of life on Earth and the statistical models to explain the importance of variation within populations for the survival and evolution of species. Ethical issues related to genetic modification of organisms and the nature of science are described. Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions.

Primary Interdisciplinary Connections: Genetics

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ ICT Literacy
☐ Information Literacy ☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy

Unit Rationale: Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Career Readiness, Life Literacies, and Key Skill (Standard 9):

9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.

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

9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately.

9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity.

9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.

Learning Targets

Standards: HS-LS3

Content Statements: Heredity: Inheritance and Variation of Traits

CPI#:	Cumulative Progress Indicator (CPI):
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.
Math.MP.2	Reason abstractly and quantitatively.

Science and Engineering Practices:

Asking Questions and Defining Problems

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze 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

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (HS-LS3-2)

Disciplinary Core Ideas (DCIs):

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) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)

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 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)

Crosscutting Concepts:

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 vs. 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. (HS-LS3-3)
- Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

Unit Essential Questions:

- What is the role of DNA in determining traits?
- What is the relationship between DNA codes and the production of proteins?
- How do DNA mutations cause harmful and beneficial variations?
- How do errors in replication cause mutations?
- How does meiosis lead to genetic variation and recombination in offspring?
- How is probability used to predict the distribution of expressed traits in generations?
- What role does the environment have in causing genetic mutations?

Unit Enduring Understandings:



- 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.
- 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.
- 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 viable mutations are inherited.
- 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.

Unit Learning Targets:

Students will....

- Use a model to illustrate the role of cellular division and differentiation to produce and maintain complex organisms.
- Explain how the process of meiosis results in the passage of traits from parent to offspring, and how that results in increased genetic diversity.
- Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- Create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced.
- Make and defend claims based on evidence that inheritable genetic variations may result from 1) new genetic recombination through meiosis, 2) viable errors occurring during replication, and/or 3) mutations caused by environmental factors.



Evidence of Learning

Summative Assessment: Unit Assessment and Labs

Equipment Needed: Student iPads, laboratory materials and supplies, safety equipment, measuring tools, calculators

Teacher Resources: Teacher laptop, textbook, laboratory materials and supplies, safety equipment, measuring tools, calculators

Formative Assessments:

- Quizzes
- Assignments
- Activities
- Labs
- Project



Lesson Plans

Lesson	Time Frame
Lesson 1 The Genetic Mix-Up – Rebuilding the Next Generation	1 day
Lesson 2 The Genetic Case Files – Tracing the "Royal" Mutation	1 day
Lesson 3 The Genetic Slot Machine – Dihybrid Simulations	1 day

Teacher Notes: Students should know the vocabulary terms like homozygous, heterozygous, dominant, recessive, genotype and phenotype. Knowledge of the three Laws of Mendel Genetics and how to complete a punnett square as well as the prediction and calculation of the ratios of dominant and recessive traits should be part of the student's knowledge prior to these unit lessons.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

- <http://learn.genetics.utah.edu/>
- <https://ghr.nlm.nih.gov/>
- http://www.sciencekidsathome.com/science_topics/genetics-a.html



Lesson Plan 1 Template

Content Area: Biology
 Time Frame: 1 day

Lesson Title: The Genetic Mix-Up – Rebuilding the Next Generation

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Model inherited traits by simulating the random assignment of alleles during fertilization. - Explain the Law of Independent Assortment by demonstrating how	Lesson Sequence Anchoring Phenomenon: Brothers and sisters can have the same parents yet display remarkably different combinations of traits. How can the same	Pedigree Analysis: Provide students with a "Secret Family History" (a list of traits from grandparents). Students must construct a Pedigree for their Avatar



different traits (on different chromosomes) are inherited separately.	two parents produce offspring that are genetically unique from one another? 2. Group students in pairs of 2. One student represents "Maternal DNA" and the other "Paternal DNA." 3. Give students "Genome Kits." Instead of random parts, provide bags containing "Chromosome Strips" (strips of paper with genotypes like \$Aa\$, \$Bb\$, \$Cc\$) representing a variety of inherited traits. 4. The Planning Meeting: Instruct students that the goal is to create a unique "Genetic Avatar." Students will assign specific physical traits to their alphabetical representations (e.g., \$H\$ = Hair Color, \$W\$ = Wing Shape, \$E\$ = Eye Type). 5. The Law of Independent Assortment Simulation: ○ Students do not just roll for a trait; they cut their chromosome strips to separate the alleles (\$A\$ from \$a\$).	to determine if their specific traits are consistent with a pattern of inheritance (Autosomal Dominant vs. Recessive). ● Energy and Growth Link: Discuss how the "large carbon-based molecules" (proteins) coded by these genes require energy from Cellular Respiration to actually build the physical traits seen in the Avatar.
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- They place maternal alleles in one cup and paternal in another.
 - Without looking, they pull one allele from each parent to form the offspring's genotype.
 - This demonstrates that the inheritance of "Hair Color" (H) does not affect the inheritance of "Eye Type" (E).
6. Determine the Outcome: Students record the resulting genotypes and identify the Phenotype based on the dominant/recessive rules they established earlier.
7. The Avatar Construction: Students build or draw their Avatar based on these results.
8. The "Expert Gallery Walk": Collect the Avatars. Students must move through the room and try to identify which "Parents" produced which "Offspring" based on visible traits.

Differentiation:



Small group with teacher support to fill out the worksheet. Use the computer for "wheel of chance to determine" dominant/recessive traits

Resources Provided:

- <http://genetics.thetech.org/ask/ask22>
- http://mwrightsclassroom.weebly.com/uploads/2/1/7/9/21790730/potato_head_genetics.pdf
- <https://youtu.be/CBezq1fFUEA>



Lesson Plan 2 Template

Content Area: Biology
 Time Frame: 1 day

Lesson Title: The Genetic Case Files – Tracing the "Royal" Mutation

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Learn how to use autosomal and sex-linked pedigrees to trace alleles through generations. - Trace a gene to identify carriers and affected	Lesson Sequence Anchoring Phenomenon: A mutation causing hemophilia spread through several European royal families and influenced major historical events, despite	- The Case File Pedigree: A completed, accurately coded 3-generation family tree. - The Counseling Report: A formal prediction of



individuals within a complex family tree. • Evaluate the probability of future inheritance using Punnett square calculations.	originating from a single ancestor. How can one genetic mutation persist and spread through generations of a family? 2. The Entry Event (The Case File): Instead of a worksheet, present students with a "Medical Mystery Case File" containing a partial family history of a genetic disorder (e.g., Hemophilia or Cystic Fibrosis). 3. Individual Research Phase: Students act as Genetic Counselors. They use provided digital resources or textbooks to research their assigned disorder, focusing on its symptoms and its Mode of Inheritance (Autosomal vs. Sex-linked). 4. The Pedigree Construction: Using the "Case File" notes, students must draft a formal 3-generation pedigree. a. Level 1: Identify known affected individuals (shaded). b. Level 2: Deduce the genotypes of the parents and grandparents. c. Level 3: Identify "Silent Carriers" (half-shaded) using logic.	future afflicted individuals using a Punnett square as evidence. • Personal Connection: A personal "Trait Map" where students trace a simple trait (like a widow's peak or detached earlobes) through their own family or a fictional family of their choice.
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5. **Expert Peer Review:**
Students pair up to swap pedigrees. They must "audit" their partner's work to see if the shaded symbols match the rules of that specific inheritance pattern.
6. **The "Royal" Extension:**
Introduce the European Royal Family tree. Students must trace the "Victoria Mutation" and identify how the trait moved across borders through marriages.
7. **The Predictions**
Presentation: In small groups, students create a "Genetic Counseling Report" (a brief pitch or slide) predicting the probability of a 4th-generation child having the disorder based on two specific "current" family members.
8. **Class Review:** The teacher uses a digital whiteboard to "map" the royal pedigree live, highlighting the "Is over Of" probability math (e.g., "What is the chance of this couple having an affected son?")

Differentiation:

Students may be partnered with another student to complete the activity or be placed in a teacher directed group. Students with an IEP can take the handout home if they need extra time, and/or do the even numbered questions.

Resources Provided:

- <https://www.dnalc.org/view/15990-Making-a-pedigree.html>
- <https://www.sophia.org/tutorials/how-to-make-a-pedigree-chart>



- http://www.bogari.net/Bogari/Medical_Genetics_files/3-1%20Patterens%20of%20Inheritance.pdf



Lesson Plan 3 Template

Content Area: Biology

Lesson Title: The Genetic Slot Machine – Dihybrid Simulations

Time Frame: 1 day

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Model two-trait crosses to see how alleles for different traits are inherited independently. - Determine the probability of offspring phenotypes using both	Lesson Sequence Anchoring Phenomenon: Two parents with similar traits can have children who display trait combinations that neither parent visibly	The "Slot Machine" Data Table: A record of their 16 trials compared to the expected Mendelian ratio.



Punnett Squares and the "Product Rule." • Explain the Law of Independent Assortment by physically separating "chromosome pairs."	possesses. Why do patterns of inheritance sometimes produce surprising outcomes? 2. The "Trait Tokens" (5 mins): Group students in pairs. Instead of a handout, give each pair two sets of "Trait Tokens" (colored poker chips or colored paper squares). ○ Trait 1 (Color): Blue B) is dominant over Green b. ○ Trait 2 (Shape): Round (R) is dominant over Square (r). 3. The Parent Setup: Each pair sets up two parents that are Dihybrid (BbRr). To make this hands-on, they place the B/b tokens in one cup and the R/r tokens in another cup. 4. The "Independent Assortment" Spin: Students simulate meiosis by closing their eyes and picking one token from the Color Cup and one token from the Shape Cup. * Crucial Realization: Picking a Blue token does not "force" them to pick a Round token. This is the	• The "Product Rule" Proof: A calculation page where they solve three dihybrid problems using the "multiplication method" instead of the 16-square grid. • The Personal Pedigree: A two-trait family tree showing the inheritance of their chosen traits.
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Law of Independent Assortment in action.

5. The Trial Run (10 mins): Pairs perform 16 "pickings" (fertilization events) and record the results. They will likely see that the "9:3:3:1" ratio isn't perfect in small samples, leading to a great discussion on probability vs. reality.
6. The Mathematical Shortcut: Introduce the "Product Rule." Instead of a giant 16-square box, show them how to do two small 4-square boxes (one for color, one for shape) and multiply the fractions.
7. The Personal Dihybrid Project: For the summative piece, students choose two of their own traits (e.g., Freckles and Thumb Type) and create a "Probability Forecast" for their future offspring based on their own genotype.

Differentiation:

Students with an IEP can take the handout home if they need extra time, and/or do the first Punnett square and questions in a group session and if able to may attempt to complete the second problem on their own. Additionally, a teacher and student group could be formed and the lesson could become a teacher directed mini lesson.

Resources Provided:



- https://www.biologycorner.com/bio2/genetics/notes_dihybrid.html
- <http://www.dnafb.org/5/problem.html>
- <http://www.csun.edu/~cmalone/pdf360/Cho2-2%20dihybrid.pdf>
- <https://youtu.be/i-orSv6oxSY>



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson **Strongly, Moderately** or **Weakly** meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☐	☒	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☐	☒	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Biology	Grade Level: 9	Unit Title: Heredity
Created: 2026	Board Approved on:	



Unit Overview Template

Content Area: Biology

Grade Level: 9

Unit Title: Evolution

Unit Summary: In this unit of study, 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. Students also develop an understanding of the factors causing natural selection of species over time. Additionally, students can apply concepts of probability to explain trends in populations as those trends relate to advantageous heritable traits in a specific environment. Students demonstrate an understanding of these concepts by obtaining, evaluating and communicating information and constructing explanations and designing solutions.

Primary Interdisciplinary Connections: Genetics

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ ICT Literacy
☐ Information Literacy ☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy

Unit Rationale: Students will analyze and interpret data, use mathematical and computational thinking, and construct explanations as they demonstrate understanding of the causes of natural selection that leads to evolution of a species. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Career Readiness, Life Literacies, and Key Skill (Standard 9):

9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.

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

9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.

9.4.12.CT.3: Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

Learning Targets

Standards: HS-LS4

Content Statements: Biological Evolution: Unity and Diversity

CPI#:	Cumulative Progress Indicator (CPI):
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.
Math.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
Math.S-ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
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.

Science and Engineering Practices:

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze 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-LS4-3)

Using Mathematics and Computational Thinking

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

- Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS4-6)



Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct 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. (HS-LS4-2), (HS-LS4-4)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science.

- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5)

Obtaining, Evaluating, and Communicating Information

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

- 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). (HS-LS4-1)

Disciplinary Core Ideas (DCIs):

LS4.A: Evidence of Common Ancestry and Diversity

- Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of 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. (HS-LS4-1)

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. (HS-LS4-2), (HS-LS4-3)
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

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. (HS-LS4-2)
- Natural selection leads to adaptation, that 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. (HS-LS4-3), (HS-LS4-4)
- Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)
- 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. (HS-LS4-5), (HS-LS4-6)
- 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. (HS-LS4-5)

LS4.D: Biodiversity and Humans

- 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. (HS-LS4-6) (Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-LS4-6)
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (secondary to HS-LS4-6)

Crosscutting Concepts:

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. (HS-LS4-1), (HS-LS4-3)

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-2), (HS-LS4-4), (HS-LS4-5), (HS-LS4-6)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-LS4-1), (HS-LS4-4)

Connections to Nature of Science Science

Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-LS4-1)

Unit Essential Questions:

- How is evidence related to the understanding of common ancestry and biological evolution?
- How do factors influence the number of organisms, behaviors, morphology and physiology of a species and affect their ability to compete?
- How can the shift in the numerical distribution of traits be analyzed and used as evidence of evolution?
- How can data be used to provide evidence for how specific biotic and abiotic differences in ecosystems contribute to a change in gene frequency over time, leading to adaptation of populations?
- What is the cause and effect relationship of changes in environments and distribution or disappearance of traits in species?
- What solutions can be designed for a proposed problem related to threatened or endangered species or to genetic variation of organisms?

Unit Enduring Understandings:

- All life on earth evolved from a common ancestor that first appeared billions of years ago.
- Variation exists in all species and allows some individuals to be better able to survive in a particular environment than others.
- Natural selection is the process by which evolution occurs.

Unit Learning Targets:

Students will....



- 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.
- Create or revise a simulation of a phenomenon, designed device, process, or system.
- 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.
- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments
- 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).



Evidence of Learning

Summative Assessment: Unit Assessment and Labs

Equipment Needed: Student iPads, laboratory materials and supplies, safety equipment, measuring tools, calculators

Teacher Resources: Teacher laptop, textbook, laboratory materials and supplies, safety equipment, measuring tools, calculators

Formative Assessments:

- Quizzes
- Assignments
- Activities
- Labs
- Project



Lesson Plans

Lesson	Time Frame
Lesson 1 The Linnaean Branding Challenge	1 day
Lesson 2 The Finch Island Simulation – Survival of the Best-Fit	3 days
Lesson 3 The Evidence of Evolution Hexagon Challenge	1 day

Teacher Notes: Students have been introduced to why scientists use a classification system for the diversity of life. The works of Darwin and the importance of his discovery of the finches of the Galapagos Islands and the variations of their beaks in connection with their food choices should be explored prior to the lessons.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

- <https://www.saltise.ca/activities/biology-darwins-finches/>
- <https://www.nationalgeographic.org/interactive/defender-natural-selection/>
- <https://youtu.be/oSCjhI86grU>
- https://youtu.be/aTftyFboC_M
- <http://science.howstuffworks.com/life/evolution/natural-selection.htm>
- <https://www.statedclearly.com/videos/what-is-the-evidence-for-evolution/>
- <https://youtu.be/wpKulkADzBk?list=PLwLoMyd7Dk1FoiQPGrjehze3eDpc01eVz>



Lesson Plan 1 Template

Content Area: Biology Lesson Title: The Linnaean Branding Challenge Time Frame: 1 day

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Create a mnemonic device to master the hierarchical order of the classification system. - Attribute specific terminology (Domain through Species) to a real-world organism.	Lesson Sequence Anchoring Phenomenon: Humans, mushrooms, and oak trees look completely different, yet scientists classify all of them using the same hierarchical system. How can scientists organize	The "What's Missing?" Quick-Fire: Display a classification string with one level missing (e.g., Kingdom, Phylum, _____, Order...). Students must use their



Explain the "Nested Hierarchy"—how moving down the levels increases relatedness but decreases total population.	Earth's incredible biodiversity in a way that reveals relationships among organisms? - The "Drunken King" Hook (5 mins): Introduce the concept of a mnemonic. Share the "classic" (e.g., "Dear King Philip Came Over For Good Soup") but challenge them to create something more modern or relevant to their own lives (e.g., using sports, gaming, or music references). - The "Taxonomic Sort" (10 mins): Working individually, students must develop two unique mnemonics for the eight levels: Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species. * CP Modernization: They must ensure Domain is included, as modern taxonomy always starts with the three Domains. - The "Pitch" Session: Students share their best mnemonic aloud. Instead of just writing it down, the class votes on the "Most Memorable Brand" using a quick digital poll or show of hands. - The Organelle-to-Organism Link: To reinforce the "nested" nature, students choose one "Celebrity Organism" (e.g., a Great	mnemonic to shout out the missing level. The Relatedness Check: Present two organisms (e.g., a Dog and a Wolf). Students must identify at which level their "paths diverge" (The Genus level) using their knowledge of the order.
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- White Shark, a Lion, or a Redwood Tree). They must "un-nest" the organism by listing every level of its classification.
4. The "Inverted Triangle" Model: On the back of their handout, students draw an inverted triangle. They must place their mnemonic levels inside and explain why "Species" is at the tiny point while "Domain" is at the wide top.

Differentiation:

Students with an IEP can write one mnemonic instead of a second and a favorite. English language learners can write one mnemonic and copy down a class favorite.

Resources Provided:

- <https://youtu.be/sLRlnOH22oI>
- https://youtu.be/F38BmgPcZ_I



Lesson Plan 2 Template

Content Area: Biology Lesson Title: The Finch Island Simulation – Survival of the Best-Fit
 Time Frame: 2 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Simulate natural selection by mimicking the beak adaptations of Darwin's finches.	Lesson Sequence Anchoring Phenomenon: During periods of drought in the Galápagos Islands, finches with certain beak sizes survived and reproduced	The "Fitness" Hypothesis: Before Generation 2 starts, students must write a one-sentence prediction: "I hypothesize that the



• Explain the mechanism of evolution (Variation, Selection, Inheritance). • Graph population shifts over three "Generations" to see evolution in real-time.	more successfully than others, causing the population to change over time. How can changes in environmental conditions alter the characteristics of an entire population? 2. The Variation Hook: Group students in pairs. Instead of random tools, explain that each group represents a sub-species of finch. Distribute "Beak Types": The Tongs (Large Ground Finch), The Tweezers (Cactus Finch), The Spoon (Large Tree Finch), and The Chopstick (Warbler Finch). 3. Generation 1 (The Drought): Spread a mixture of "seeds" (beans, rubber bands, and paperclips) on butcher paper. ○ Task: Students have 45 seconds to gather as many "seeds" as possible into their "Stomach" (cup). ○ The Rule: To "survive" to the next round, a finch must collect at least 20 units of food. 4. Data & Reproduction: Students record their catch. ○ If they survived: They "reproduce." A new student pair	[Beak Type] will increase in frequency because..." • The Adaptation Sketch: Students draw their "Modern Organism" and must label three Selective Pressures (e.g., Predation, Climate, Food Scarcity) that drove its evolution.
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	joins their beak phenotype. ○ If they "died": That beak type is removed from the island. ○ Math Link: Use the "Percent Change" to show how the population of Tweezer-beaks increased while Spoon-beaks decreased. 5. Generation 2 (The Shift): Change the environment! Remove the beans and leave only the rubber bands (simulating a change in available food due to weather). Repeat the simulation. 6. Graphing the Shift: Students create a Multi-Line Graph. The X-axis is "Generation" (1, 2, 3) and the Y-axis is "Number of Individuals." Students will see the lines cross as one trait becomes dominant. 7. The Naturalist's Journal: Instead of a PowerPoint, students act as Charles Darwin. They research a Galapagos organism (like the Marine Iguana) and write a 1st-person journal entry comparing it to a mainland relative (the Green Iguana), illustrating the specific adaptations that allowed	
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	it to survive in its unique environment.	
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Differentiation:

Students who are not able to participate can only record the data and not participate in the picking of the beans. Students with an IEP can take the handout home if they need extra time. They can also graph only their group's data and not the other four groups. Graphing programs (excel, etc.) could be utilized to enable students with fine motor skill issues to create a graph. Students may also use Flipgrid to verbally explain their results.

Resources Provided:

- <https://youtu.be/l25MBq8T77w>
- <https://www.saltise.ca/activities/biology-darwins-finches/>



Lesson Plan 3 Template

Content Area: Biology Lesson Title: The Evidence of Evolution Hexagon Challenge
 Time Frame: 1 day

Lesson Components

21st Century Themes

- ☒ Global Awareness ☐ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21st Century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☐ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Genetics

Integration of Technology:

Student iPads for accessing instructional resources, simulations, and scientific databases
 Digital data collection and analysis tools for organizing and interpreting experimental results
 Google Workspace applications (Docs, Sheets, Slides) for collaboration, data analysis, and presentations
 Multimedia resources, videos, and interactive models to support biological concepts
 Digital presentation tools for communicating findings, explanations, and scientific arguments

Equipment Needed:

Student iPads
 Laboratory materials and supplies appropriate to the investigation
 Safety equipment (goggles, gloves, aprons as needed)
 Measuring tools and laboratory equipment
 Calculators
 Data collection sheets or laboratory notebooks
 Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Match key vocabulary (Natural Selection, Homologous Structures, Vestigial Organs, etc.)	Lesson Sequence Anchoring Phenomenon: The arm of a human, the wing of a bat, and the flipper of a whale perform completely	The "Odd One Out" Challenge: Display three terms and one definition (two of which match). Students must use their



with definitions and real-world examples. - Analyze the "Lines of Evidence" for evolution, including embryology, the fossil record, and molecular biology. - Explain how specific structures demonstrate common ancestry or environmental adaptation.	different functions but share nearly identical bone structures. Why do organisms that appear so different possess such remarkably similar anatomical features? - The "Line of Evidence" Hook: Group students in pairs. Show a series of images (e.g., the arm of a human, the wing of a bat, and the flipper of a whale). Ask: "If these animals live in different environments, why is their bone structure nearly identical?" - The Hexagon Puzzle Construction: Provide students with a "Genome Bag" containing hexagonal puzzle pieces. - Side A: Vocabulary Term (e.g., Vestigial Structure). - Side B: Scientific Definition (e.g., A structure that has lost its original function through evolution). - Side C: Real-world Case Study (e.g., Pelvic bones in a whale or the human appendix). - Collaborative Sorting: Students must link the hexagons together on their desks so that all touching sides match correctly.	mnemonic or puzzle knowledge to identify the "imposter" term that doesn't belong in that line of evidence. The Case Study Sketch: On the back of their puzzle guide, students must choose one "Evidence" term (like Fossil Record) and sketch a transition (like the evolution of the horse or the whale) to show "Descent with Modification."
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- CP Modernization:
Instead of just using a textbook, students use a "Digital Evidence Board" (a curated Padlet or site list) to verify the case studies for terms like Biogeography or Comparative Embryology.
- 5. The "Gallery Audit":
Once a group completes their geometric puzzle, they must "Audit" another group's puzzle. If they find a mismatch, they must provide the correct definition as "Evidence."
- 6. Digital Reinforcement:
Students take a photo of their completed puzzle to use as a visual study guide. This photo is then used as the "answer key" for a gamified review like a Gimkit or Blooket.

Differentiation:

Students with an IEP are encouraged to work in groups. If additional time is required for completion, these students may take the assignment home to complete it.

Resources Provided:

- <https://www.nationalgeographic.org/interactive/defender-natural-selection/>
- <https://youtu.be/oSCjhI86grU>
- https://youtu.be/aTftyFboC_M
- <http://science.howstuffworks.com/life/evolution/natural-selection.htm>



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson **Strongly, Moderately** or **Weakly** meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☐	☒	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☒	☐	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☐	☒	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☐	☒	☐

Curriculum Design Template

Content Area: Biology	Grade Level: 9	Unit Title: Evolution
Created: 2026	Board Approved on:	



Unit Overview Template

Content Area: Honors Biology **Grade Level:** 9 **Unit Title:** Biology of Earth Systems and Biodiversity

Unit Summary: This unit explores how living organisms interact with each other and with Earth's atmosphere, hydrosphere, geosphere, and biosphere through the cycling of matter and flow of energy. Students investigate biodiversity, ecosystem stability, carbon cycling, evolution, and the coevolution of life and Earth systems while analyzing the impacts of human activities on natural systems. Through modeling, data analysis, simulations, and engineering design, students evaluate solutions that promote biodiversity, sustainability, and the long-term health of Earth systems.

Primary Interdisciplinary Connections: Environmental Science

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ ICT Literacy
☒ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy

Unit Rationale: Understanding the interactions between biological systems and Earth systems enables students to explain how life influences and is influenced by environmental change while developing evidence-based solutions to sustainability and biodiversity challenges.

Career Readiness (Standard 9):

- 9.2.12.CAP.4: Evaluate different careers and develop various plans.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.2.12.CAP.13: Analyze how the economic, social, and political conditions of a time period can affect the labor market.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.
- 9.4.12.IML.1: Compare search browsers and recognize features that allow for filtering of information.
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.

Learning Targets

Standards: HS-LS1, HS-LS2, HS-LS4, HS-ESS2, HS-ESS3, HS-ETS1



Content Statements: From Molecules to Organisms: Structures and Processes; Ecosystems: Interactions, Energy, and Dynamics; Biological Evolution: Unity and Diversity; Earth’s Systems; Earth and Human Activity; Engineering Design

CPI#:	Cumulative Progress Indicator (CPI):
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-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
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-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.
HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
Math.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
Math.S-ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
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.

Science and Engineering Practices:



Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-5), (HS-LS1-7)
- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5), (HS-ESS2-6)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science.

- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5)
- Construct an oral and written argument or counter-arguments based on data and evidence. (HS-ESS2-7)

Using Mathematics and Computational Thinking

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

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3)
- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)
- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions 9–12 builds on K – 8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

- Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2)

Disciplinary Core Ideas (DCIs):



LS1.C: 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-LS1-5)
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-7)

LS2.B: 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-LS2-5)

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. (HS-LS2-7)

LS4.C: Adaptation

- 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. (HS-LS4-5)
- 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. (HS-LS4-5)

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)
- 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. (secondary to HS-LS2-7)

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. (secondary to HS-LS2-5)

ESS2.D: Weather and Climate



- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6), (HS-ESS2-7)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6)

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. (HS-ESS2-7)

ESS3.C: Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)

ESS3.D: Global Climate Change

- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

ETS1.C: Optimizing the Design Solution

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (HS-ETS1-2)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (secondary to HS-LS2-7).
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

Crosscutting Concepts:

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. (HS-LS1-5)
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS1-7)
- The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6)

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 scales. (HS-LS2-5), (HS-ETS1-4)
- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-7), (HS-ESS2-7)
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3)

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-5)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Modern civilization depends on major technological systems. (HS-ESS3-3)
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3)

Connections to Nature of Science

Science is a Human Endeavor

- Science is a result of human endeavors, imagination, and creativity. (HS-ESS3-3)

Unit Essential Questions:

- How do organisms capture, transform, and transfer energy and matter within living systems and across Earth systems?
- How are ecosystems and Earth systems interconnected through the cycling of carbon and other materials?
- How do changes in environmental conditions influence the stability, diversity, and evolution of life on Earth?
- In what ways do human activities modify Earth systems and biodiversity?
- How can scientific understanding and engineering design be used to address environmental challenges and promote sustainability?

Unit Enduring Understandings:

- Energy and matter are continuously cycled through biological and Earth systems, connecting all living and nonliving components of the planet.



- Photosynthesis and cellular respiration are fundamental processes that drive the flow of energy and carbon through ecosystems.
- Ecosystems can remain stable over time but are sensitive to changes in environmental conditions that may disrupt balance and biodiversity.
- Evolution and natural selection are influenced by environmental change and contribute to the coevolution of life and Earth systems.
- Human activities can significantly alter Earth systems, biodiversity, and resource availability, often across multiple scales.
- Scientific modeling, data analysis, and engineering design are essential tools for understanding and addressing complex environmental challenges.

Unit Learning Targets:

Students will...

- Explain how photosynthesis and cellular respiration transfer energy and matter within biological systems.
- Model how carbon cycles through organisms and Earth systems, including the atmosphere, biosphere, hydrosphere, and geosphere.
- Analyze how ecosystem stability can change in response to environmental disturbances.
- Use evidence to explain how changes in environmental conditions can lead to adaptation, speciation, or extinction.
- Construct explanations for how biodiversity and ecosystem health are influenced by natural and human-driven changes.
- Evaluate the impacts of human activity on Earth systems and propose ways to reduce negative effects.
- Use computational or conceptual models to represent interactions among organisms and Earth systems.
- Develop and evaluate solutions to environmental problems using scientific and engineering principles.
- Communicate scientific explanations using evidence from models, data, and investigations.



Evidence of Learning

Summative Assessment: Unit Assessment and Labs

Equipment Needed: Student iPads, laboratory materials and supplies, safety equipment, measuring tools, calculators

Teacher Resources: Teacher laptop, textbook, laboratory materials and supplies, safety equipment, measuring tools, calculators

Formative Assessments:

- Quizzes
- Assignments
- Activities
- Labs
- Project



Lesson Plans

Lesson	Time Frame
Lesson 1 The Carbon Pathway — From Sunlight to Life	3 days
Lesson 2 When Systems Break Balance — Biodiversity and Environmental Change	3 days
Lesson 3 Designing for a Changing Planet — Engineering Sustainability Solutions	3 days

Teacher Notes: This unit is built around the idea that biological systems cannot be separated from Earth systems—carbon cycling, energy flow, and ecosystem stability are interconnected across scales from molecules to global systems. Students should be consistently pushed to connect cellular processes (photosynthesis and respiration) to large-scale phenomena such as climate change, biodiversity loss, and resource management. Emphasis should be placed on modeling, data analysis, and argumentation from evidence, with frequent opportunities for students to engage in collaborative problem-solving and design thinking. The engineering components of the unit are intended to be authentic and open-ended, allowing students to evaluate trade-offs in real-world sustainability challenges that involve environmental, economic, and societal considerations.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

<https://www.biointeractive.org/>

<https://www.ck12.org/student/>

<https://phet.colorado.edu/en/simulations/filter?subjects=biology&type=html>

<http://www.pbs.org/wgbh/evolution/educators/teachstuds/svideos.html>



Lesson Plan 1 Template

Content Area: Honors Biology Lesson Title: The Carbon Pathway — From Sunlight to Life
 Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Environmental Science

Integration of Technology:

- Google Sheets for carbon flow data tracking and graphing (photosynthesis vs respiration models)
- PhET simulation: Photosynthesis and Greenhouse Effect
- Vernier Go Direct CO₂ sensors to measure CO₂ changes in respiration/plant activity demonstrations
- Google Slides for group modeling presentations of carbon pathways
- Short video analysis using HHMI BioInteractive carbon cycle clips

Equipment Needed:

- iPads
- Elodea or similar aquatic plants (or spinach leaf disks for floating disk lab)
- Baking soda solution (CO₂ source for plants)
- Clear cups or beakers
- Desk lamps or light sources
- CO₂ probes (Vernier if available) or alternative indicator setup (BTB solution)
- Stopwatch/timers
- Graph paper
- Printed carbon cycle diagram templates

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Model how photosynthesis and cellular respiration move carbon and energy through living systems • Collect and analyze experimental data showing changes in CO₂	Lesson Sequence Anchoring Phenomenon: “Why is CO₂ rising in places full of plants?” 1. Students observe a short data set and video showing:	• Initial hypothesis (written explanation of phenomenon) • Lab data accuracy and participation checklist • Google Sheets graph (trend + labeling check)



under different environmental conditions • Explain how biological processes connect to global carbon cycling and climate systems • Use models and simulations to connect cellular-level processes to Earth system-scale phenomena • Evaluate how human and industrial activity influences natural carbon cycles	○ CO₂ levels increasing in a sealed terrarium containing plants ○ Nighttime spikes in CO₂ in plant-rich environments ○ Global atmospheric CO₂ trends over time 2. Students individually record initial explanations for how CO₂ can increase in systems with abundant plant life 3. Class discussion surfaces competing ideas and establishes the guiding question: How can biological systems both remove and release carbon dioxide? Building Initial Explanations 4. Students share and compare initial models or explanations in small groups 5. Class constructs a working list of “what we think we know” about plants, photosynthesis, and gas exchange 6. Teacher introduces the idea that systems may behave differently depending on conditions (light, time, inputs, outputs)	• PhET simulation reflection questions • Carbon model (must show at least 3 accurate carbon pathways) • Exit ticket: ○ Explain why CO₂ can increase even when plants are present ○ Identify one human activity that affects carbon cycling and explain how
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Investigation: Testing
Carbon Exchange in
Living Systems

7. Students conduct a controlled investigation using Elodea or leaf disks
 - One setup exposed to light
 - One setup kept in dark conditions
8. Students measure changes in oxygen or CO₂ using probes or indicator solution
9. Data is collected systematically and entered into Google Sheets

Making Sense of Data

10. Students graph and analyze experimental results
 - Comparing light vs dark conditions
 - Identifying when carbon dioxide is being used or produced
11. Students reconcile results with initial explanations and identify where their thinking needs revision

Connecting to
System-Level Behavior

12. Students use PhET simulations to manipulate variables in photosynthesis and carbon cycling
 - Light intensity
 - CO₂ concentration



	○ Number of producers 13. Students compare simulation behavior to lab data and identify what the model helps explain and what it does not Constructing a Carbon Flow Model 14. Students build a visual model of carbon movement through: ○ Atmosphere ○ Producers ○ Consumers ○ Decomposers 15. Students revise models after peer critique and new evidence from investigation and simulation Extending to Real-World Systems 16. Students examine real-world carbon data showing: ○ Industrial CO₂ emissions ○ Fossil fuel energy production ○ Natural carbon cycling processes 17. Students analyze how human activity alters the balance of carbon movement in Earth systems 18. Students evaluate a scenario comparing energy production	
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	choices and their environmental impacts Final Synthesis 19. Students revise and finalize carbon cycle models 20. Students write an explanation of the phenomenon using evidence from: ○ Lab investigation ○ Simulation results ○ Real-world data 21. Class discussion connects cellular processes to global carbon cycling and system-level change	
Differentiation: ● Scaffolded carbon cycle diagrams (partial → full modeling progression) ● Sentence frames for explanations of energy vs matter flow ● Optional extension: quantify emissions using simplified datasets ● Choice of model format (digital, physical, diagrammatic) ● Structured lab roles (data collector, analyzer, presenter, model builder) ● Enrichment: real NASA/NOAA carbon datasets for advanced analysis		
Resources Provided: ● Carbon cycle modeling templates (leveled) ● Lab procedure handouts ● Google Sheets graphing template ● PhET simulation guide sheet ● Exit ticket prompts ● Anchor phenomenon data set (CO₂ time-series) ● Model rubric/checklist		



Lesson Plan 2 Template

Content Area: Honors Biology Lesson Title: When Systems Break Balance — Biodiversity and Environmental Change Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Environmental Science

Integration of Technology:

- Google Sheets for analyzing ecosystem population data and graphing trends over time
- PhET simulation (Natural Selection / ecosystem balance simulations) for modeling population changes under environmental stress
- NOAA / NASA ecosystem and climate data sets accessed via student devices
- Google Slides for constructing and revising ecosystem interaction models
- Short video/data sets from HHMI BioInteractive (coral bleaching, invasive species, ecosystem shifts)

Equipment Needed:

- Student iPads
- Printed or digital ecosystem data sets (predator-prey, invasive species, population collapse scenarios)
- Ecosystem simulation access (PhET or equivalent)
- Chart paper or digital modeling tools
- Colored markers (for system models if done on paper)
- Model templates (ecosystem interaction diagrams)
- Sticky notes for peer feedback on models

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Analyze real and simulated data to identify patterns of stability and change in ecosystems • Explain how interactions among organisms and	Lesson Sequence Anchoring Phenomenon: “Why do ecosystems collapse suddenly after appearing stable?”	• Initial written explanation of ecosystem collapse phenomenon • Data analysis checks during Google Sheets



environmental conditions influence ecosystem balance • Use models to represent relationships within ecosystems, including feedback effects • Evaluate how disturbances (natural or human-caused) affect biodiversity and population stability • Develop evidence-based explanations for ecosystem collapse or recovery	1. Students observe multiple real-world cases: ○ Coral reef bleaching events ○ Algal blooms in freshwater systems ○ Invasive species rapidly overtaking ecosystems ○ Sudden population crashes in predator-prey systems 2. Students record observations about what changes across all systems and what remains consistent 3. Class discussion generates initial ideas about what causes ecosystem instability 4. Students develop initial explanations for why ecosystems can shift rapidly 5. Groups compare explanations and identify common proposed causes (resource change, species interaction, external disturbance) 6. Teacher introduces guiding question: What determines whether an ecosystem stays stable or changes dramatically? 7. Students analyze multiple ecosystem data sets showing population changes over time: ○ Predator-prey cycles	graphing (accuracy, trends, labeling) • Simulation response questions (predict → test → revise cycle) • Ecosystem model checkpoint (must show interactions + at least one feedback loop) • Exit task: ○ Explain one reason ecosystems can remain stable and one reason they can rapidly change ○ Use evidence from data or simulation to support response
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	○ Invasive species growth curves ○ Ecosystem recovery vs collapse scenarios 8. Students graph data in Google Sheets and identify patterns of stability and disruption 9. Students compare across ecosystems to identify similarities in system behavior 10. Students use ecosystem simulation tools to manipulate variables such as: ○ Resource availability ○ Introduction/removal of species ○ Reproduction or survival rates 11. Students compare simulation outcomes to real-world case studies and adjust explanations based on results 12. Students construct a systems model of an ecosystem showing: ○ Organism interactions ○ Energy and resource flow ○ Feedback loops (stabilizing and destabilizing) 13. Students revise models based on peer feedback and evidence from data and simulations 14. Students analyze a scenario involving human impact on ecosystems	
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	(e.g., deforestation, overfishing, nutrient runoff, urban expansion) 15. Students evaluate how human activity alters system stability and biodiversity 16. Students propose potential responses or mitigation strategies and discuss trade-offs in each option 17. Students finalize ecosystem models and write an explanation of: ○ Why ecosystems remain stable in some conditions ○ Why they shift rapidly in others ○ How human activity can accelerate or reduce these changes 18. Class discussion connects ecosystem stability to broader Earth system interactions and long-term environmental change	
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Differentiation:

- Scaffolded ecosystem data sets (simplified vs complex)
- Guided graphing templates in Google Sheets for support learners
- Extension datasets including multi-variable ecosystem interactions
- Choice of representation (digital model, paper model, or hybrid)
- Structured roles in group work (data analyst, model builder, discussion leader)
- Sentence frames for explaining cause-and-effect relationships

Resources Provided:

- Ecosystem data sets (tiered complexity)
- Simulation instruction guide
- Google Sheets graphing template
- Ecosystem modeling templates (blank and scaffolded)



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- Exit ticket prompts
- Case study handouts (coral bleaching, invasive species, algal blooms)
- Model rubric/checklist



Lesson Plan 3 Template

Content Area: Honors Biology Lesson Title: Designing for a Changing Planet — Engineering Sustainability Solutions Time: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Environmental Science

Integration of Technology:

- Google Sheets for comparing energy use, emissions data, and environmental impact across different energy sources
- PhET simulations (Greenhouse effect / energy forms and changes) to model climate impacts of different energy choices
- Vernier Go Direct sensors to explore temperature or CO₂ changes in controlled demonstrations
- Google Slides or Canva for designing and presenting engineering solutions
- Online data sets from NOAA or NASA for real-world climate and emissions analysis
- Video case studies from HHMI BioInteractive or National Geographic on climate impacts and mitigation strategies

Equipment Needed:

- Student iPads
- Printed or digital climate data sets (CO₂ levels, temperature trends, energy use by source)
- Engineering design templates (problem, criteria, constraints, solution planning)
- Graph paper or digital spreadsheet tools
- Materials for prototype modeling (cardboard, markers, tape)
- Simulation access (PhET or equivalent)
- Sticky notes for peer feedback and iteration cycles

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Analyze real-world data to evaluate the impact of human energy use on Earth systems • Model how energy choices influence Earth	Lesson Sequence Anchoring Phenomenon: “Why do some communities experience more severe climate impacts than others?” 1. Students observe case studies showing:	• Initial written explanation of Earth system impact phenomenon • Data analysis checks in Google Sheets (graphs,



systems and carbon cycling • Identify and define criteria and constraints for engineering solutions to climate-related problems • Develop and compare multiple design solutions to reduce environmental impact • Evaluate trade-offs among economic, environmental, and societal factors • Communicate and defend an evidence-based engineering solution	○ Coastal flooding differences between regions ○ Urban heat island effects in cities ○ Drought severity variations across agricultural regions ○ Energy use and emissions differences between countries 2. Students record initial observations about patterns and differences across regions 3. Class discussion develops initial ideas about why climate impacts are unevenly distributed 4. Students develop initial explanations for how energy use might influence Earth system impacts 5. Groups compare ideas and identify key factors (energy sources, geography, population density, infrastructure) 6. Teacher introduces guiding question: how can human energy choices reduce impacts on Earth systems? 7. Students analyze data sets showing: ○ CO₂ emissions by energy source ○ Temperature trends over time ○ Energy consumption	trends, and interpretations) • Simulation response prompts (prediction, testing, revision cycle) • Engineering design checkpoints: ○ Defined problem statement ○ Identified criteria and constraints ○ Draft solution concepts • Exit task: ○ Explain how energy choices affect Earth systems ○ Justify a proposed solution using evidence from data or models
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	patterns across regions 8. Students use Google Sheets to graph and compare trends 9. Students identify relationships between energy use and Earth system changes 10. Students use PhET simulation to model greenhouse gas effects and energy flow in Earth's atmosphere 11. Students manipulate variables such as greenhouse gas concentration and energy input 12. Students compare simulation results to real-world climate data 13. Students begin engineering design challenge: ○ Design a system, policy, or technology to reduce Earth system impacts from energy use 14. Students identify criteria and constraints including: ○ Cost ○ Efficiency ○ Environmental impact ○ Feasibility ○ Scalability 15. Students develop at least two possible solutions 16. Students evaluate and compare solutions using	
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GLOBAL SKILLS

IEP AND 504 ACCOMMODATIONS AND MODIFICATIONS FOR EARLY CHILDHOOD AND ELEMENTARY SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
Review of directions
Use of mnemonics
Have student restate information
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Use of a study carrel
Assistance in maintaining uncluttered space
Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Use of manipulatives
No penalty for spelling errors or sloppy handwriting
Follow a routine/schedule
Alternate quiet and active time
Teach time management skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Adjusted assignment timelines
Visual daily schedule



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GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Untimed tests
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book tests
Read test and directions to student
Provide study outline prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator and/or number line for math tests
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS MODIFICATIONS:



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GLOBAL SKILLS**

Breaks between tasks
Cue expected behavior
Daily feedback to student
Have contingency plans
Use de-escalating strategies
Use positive reinforcement
Use proximity/touch control
Use peer supports and mentoring
Model expected behavior by adults
Have parent sign homework
Have parent sign behavior chart
Set and post class rules
Chart progress and maintain data



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GLOBAL SKILLS**

IEP AND 504 ACCOMODATIONS AND MODIFICATIONS FOR MIDDLE AND HIGH SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
A locker with adapted lock
Review of directions
Review sessions
Use of mnemonics
Have student restate information
Provision of notes or outlines
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Weekly or bi-weekly home-school communication
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Lab and math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of tape recorder for lectures
Use of Interactive notebook
Use of a scribe
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Ability to type all assignments
Follow a routine/schedule
Teach time management and organizational skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Daily check-in with case manager or special education teacher
Adjusted assignment timelines
Visual daily schedule



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**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book or open-note tests
Read test and directions to student
Provide study guides prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Pace long-term projects
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Allow outlining, instead of writing for an essay or major project
Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator for math tests
Film or video supplements in place of reading text
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands



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GLOBAL SKILLS**

Pass/no pass option
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS FOR STUDENTS:

- Breaks between tasks
- Cue expected behavior
- Daily feedback to student
- Have contingency plans
- Use de-escalating strategies
- Use positive reinforcement
- Use proximity/touch control
- Use peer supports and mentoring
- Model expected behavior by adults
- Have parent sign homework
- Set and post class rules
- Chart progress and maintain data



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GLOBAL SKILLS

Accommodations and Modifications for ESL Students

- Give tests orally
- Give instructions/directions in writing and orally
- Assign a peer tutor, same language or English speaking
- Allow use of bilingual/translation dictionary
- Provide summaries of text or study guides of particular chapters
- Allow errors in speaking
- Allow errors in writing
- Accept writing in first language
- Highlight key vocabulary
- Reduce amount of work required
- Assess comprehension through demonstration or other alternative means (gestures, drawings)
- Rephrase questions, directions, and explanations
- Reduce multiple choices on assessments
- Provide study guides and/ or outlines
- Shorten reading assignments
- Allow extended time for test/project completion
- Use of audio books
- Use of graphic organizers
- Use reduced text, so that print is not dense
- Use visuals/pictures throughout lesson/unit/assignment
- Adapt homework to reflect language proficiency/home support
- Adapt homework to reflect home support
- Provide hands-on activities and explanations
- Allow extended time to answer questions, and permit drawing, as an explanation
- Use of translation dictionaries to locate words in the native language
- Use anecdotal records and portfolio of work as forms of assessment
- Use story retellings to assess comprehension

What Does the Gifted and Talented Experience Look Like? *Springfield Public Schools*

Mission Statement

The Gifted and Talented Program of the Springfield Public Schools aims to provide a meaningful and rigorous education that instills the value of lifelong learning and empowers all students to reach their full potential and become self-fulfilled creative leaders in accordance with the comprehensive standards of our state. We accomplish this by offering challenging, real-world experiences in a student-centered environment.

We recognize that students come from diverse socioeconomic, cultural, and ethnic backgrounds, and the mission of the gifted and talented program is to provide opportunities for students to explore their intellectual, creative, and artistic gifts and talents within the classroom and with beyond-the-classroom experiences. It is essential to provide diverse, appropriate, and ongoing learning experiences and environments that incorporate students' academic, psychological, and social needs. Our responsibility is to provide students with educational alternatives that teach, challenge, and expand their knowledge, while simultaneously stressing the development of independent and self-directed learners who continuously generate questions, analyze, synthesize, and evaluate information and ideas.

New Jersey Administrative Code 6A:8-3.1 defines students who are gifted and talented as those students who possess or demonstrate high levels of ability in one or more content areas when compared to their chronological peers in the local district and who require modification of their educational program if they are to achieve in accordance with their capabilities.

Goals:

To support our mission, we have established the following goals to guide our work:

- To infuse into the general education program a broad range of activities for high-level learning that will challenge all students to perform at advanced levels, and provide extended opportunities, resources, and support in particular areas where student interest or talent is demonstrated.
- To provide a continuum of gifted education services that will strengthen the total school program, offer enriching and challenging learning opportunities for all students, and provide specialized learning experiences
- To promote achievement of students' best potentials and increased ability.

Through a productive and collaborative relationship among the building principals, classroom teachers, and the Gifted and Talented teacher, our schools can create programming that will enhance the learning experience for every student and serve the unique and specialized needs of students currently demonstrating gifted behaviors.

Elements of the Schoolwide Enrichment Model, W.I.N (What I Need), differentiated instruction, advanced classes, or individual programs into a student's regular instruction program are integral to this overarching framework for gifted education in the Springfield School District.

Reference Board Policy and Regulation 2464 – Gifted and Talented Pupils (M)

Early Childhood Center **Edward V. Walton**

Schoolwide Virtual Enrichment

All first and second grade students have access to the [Gifted and Talented Virtual Classroom](#). This virtual classroom is a space for students to complete various challenges and enrichment opportunities at their own pace. Students can receive feedback and additional adaptable resources to meet their individual learning needs. The virtual classroom design expands accessibility to enrichment resources and allows students to choose learning activities according to their unique interests and abilities. The purpose of the activities is to encourage problem-solving, develop critical thinking

skills, and expand curiosity and imagination. Activities are aligned to the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

The Gifted and Talented teacher serves as a resource to all teachers within Edward V. Walton School. Teachers seeking resources for their high-ability learners will receive additional support from the Gifted and Talented teacher in various ways. This support may include additional units of study, challenging resources, and student projects.

Elementary Schools **James Caldwell** **Thelma L. Sandmeier**

The goal is to engage small groups of students in intensive learning experiences through standards-based, rigorous, and relevant units of study that supplement, not supplant, the grade-level curriculum and support students' unique learning needs.

Enrichment Experience Grade 3

Beginning in third grade, the G&T teacher will cycle through all classrooms to work on problem-solving and enrichment tasks with students. Driven by assessment data, academic performance, student interest, and teacher observation, small groups of students will meet with the G&T teacher during W.I.N. (What I Need) periods throughout the week that the teacher is assigned to their classroom teacher. Groupings will be flexible and monitored to best meet each student's needs throughout the school year. Activities will include brain teasers, puzzles, strategic thinking, problem-solving, and STEM challenges.

Targeted Gifted and Talented Programing Grades 4-5

Students may become identified as Gifted and Talented in fourth grade. Students that are identified may receive support from the G&T Teacher for up to five periods (200 minutes) a week during W.I.N. (What I Need) periods. Identified students will meet to explore grade-level content while incorporating depth and complexity in a student-centered, problem-based environment. The Gifted and Talented Program aims to provide students with various advanced and challenging learning experiences across content areas to promote independent thinking skills, refine critical thinking and communication skills, cultivate joy in learning, and expand student interests through problem-solving. The instruction that students receive incorporates 21st Century Skills and advanced content that is challenging, hands-on, and relevant to the real world.

Strategies and Practices that Support Gifted and Talented Students

- Adjusted Pace of Lessons
- Inquiry-Based Instruction
- Higher-Order Thinking Activities
- Interest-Based Content
- Real World Problem Solving/Problem Based Learning
- Independent Study/Passion Projects
- Units of Study with Like-Minded Peers

Schoolwide Virtual Enrichment

All JCS and TLS students have access to grade level-specific [Gifted and Talented Virtual Classrooms](#). These virtual classrooms are a space for students to complete various challenges and enrichment opportunities at their own pace. Students are able to receive feedback and additional opportunities based on their needs. The virtual classrooms have expanded the accessibility of enrichment resources directly to the students and allows for students to choose opportunities according to their interests and abilities. The purpose of the activities is to encourage problem solving, develop critical thinking skills, and expand curiosity and imagination in conjunction with the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

In addition to classroom support, the Gifted and Talented teacher also serves as a resource to all teachers in the building. Teachers that are seeking resources for their high ability learners will receive additional support from the Gifted and Talented teacher in various ways. This may include additional units of study, challenging resources, student projects, and meeting with the G&T teacher as needed.

Additional Enrichment Opportunities

Across all grade levels 3-5, as recommended by the classroom teacher, students exhibiting a need for additional enrichment may have the opportunity to meet with the G&T teacher as the schedule allows. Groupings will be flexible and monitored to best meet the students' needs throughout the school year. Activities will include, brain teasers, puzzles, strategic thinking activities, problem-solving challenges, and STEM challenges. Students engage in an extended process of asking questions, using resources, and developing answers that lead to thinking about what and how they are learning. Students are held accountable for how they work and use their time by demonstrating their learning through products or presentations.

Students self-select to participate in individual and/or group projects based on interest and commitment. The classroom teacher and/or the enrichment teacher will help guide and monitor student exploration of chosen topics, facilitating their learning with resources and teaching of needed skills.

Secondary Schools
Florence M. Gaudineer Middle School
Jonathan Dayton High School

Grades 6-12: Access to specific content programs with higher levels of academic challenges (i.e. Pre-Algebra, Accelerated Communication Arts, and Advanced Placement Classes)

Dual Credit Courses provide students the opportunity to obtain high school credit, and college credit, simultaneously through partnerships with several institutions.

Project Lead the Way (PLTW) students become builders of technology by engaging in real world activities. Students are empowered as design thinkers collaborating on real world projects.

Gifted and Talented Identification Criteria

The Springfield Schools Gifted and Talented Program recognizes that students require differentiated learning experiences beyond the core curriculum being taught because of their advanced abilities in one or more content areas. These students may also have other cognitive qualities such as curiosity, creativity, motivation, leadership, and passion that require modifications to their academic experience.

Multiple Measures of Eligibility

Kindergarten through grade twelve identification process for gifted and talented students includes multiple measures. Multiple measures may include but are not limited to: achievement test scores; grades; student performance or products; intelligence testing; parent, student, and/or teacher recommendation; and other appropriate measures. The identification methodology is developmentally appropriate, non-discriminatory, and related to the programs and services offered by the Springfield School District. The identification procedures are reviewed annually.

According to N.J.A.C. 6A:8-3.1, all public school districts must have a board-approved gifted and talented identification process and provide services for identified students enrolled in the grades of that school district. The regulations require that identification and services be made available to students in grades K-12.

When students are recommended for the Gifted and Talented Program there are multiple measures that are considered to determine if services are necessary and appropriate. The assessments used are as follows:

- Cognitive Abilities Test (CogAT)
- Classroom Performance/Student Portfolios
- DRA2 Level
- iReady Diagnostic Scores
- Gifted Indicators Checklist
- Start Strong/NJSLA Assessment Data

The N.J.A.C. requires that students be compared to their chronological peers in the local school district. The New Jersey Department of Education has not established state-level criteria for identifying students who are gifted, such as mandated tests or assessments, grade point averages, or IQ scores. Local school districts must use multiple measures to identify students.

Procedures

<https://www.straussesmay.com/seportal/Public/DistrictPolicy.aspx?policyid=2464&id=b8a33a9f505e4998a6db3fb8e1de778b>

Gifted and Talented Program Identification Matrix

Minimum Score Required for Consideration: 14 Points

1 Point	2 Points	3 Points
Cogat Assessment Overall Stanine Score of a 7	Cogat Assessment Overall Stanine Score of an 8	Cogat Assessment Overall Stanine Score of a 9
iReady Math Assessment Just Below Current Grade Level	iReady Math Assessment On Grade Level	iReady Math Assessment ½ Year + Above Current Level
iReady ELA On Grade Level	iReady ELA ½ Year Above Current Level	iReady ELA One Full Grade Level + Above Current Level
NJSLA Math Approaching Expectations	NJSLA Math Met Expectations	NJSLA Math Exceed Expectations
NJSLA ELA Approaching Expectations	NJSLA ELA Met Expectations	NJSLA ELA Exceed Expectations
HOPE Teacher Rating Scale Raw Score: 11 - 29	HOPE Teacher Rating Scale Raw Score: 30 - 49	HOPE Teacher Rating Scale Raw Score: 50-66

Team meetings present the opportunity to review data and assess the educational needs of all students. Teacher provides examples of student work exhibiting above and beyond grade level expectations, creativity, leadership, critical and abstract thinking. Programs for gifted and talented students will be periodically evaluated for their continuing efficacy and adjusted accordingly. The parent of any student identified as gifted or talented shall be consulted regarding any program designed to address the student's particular needs.

Resource Links

https://riversideinsights.com/cognitive_abilities_test

<https://www.curriculumassociates.com/programs/i-ready-learning>

<https://www.nj.gov/education/assessment/resources/>

<https://www.routledge.com/HOPE-Teacher-Rating-Scale-Involving-Teachers-in-Equitable-Identification/Gentry-Pereira-Peters-McIntosh-Fugate/p/book/9781618214522#:~:text=The%20HOPE%20Teacher%20Rating%20Scale,making%20it%20easy%20to%20use.>

Gifted and talented student: The “*[Strengthening Gifted and Talented Education Act](#)*” defines a gifted and talented student as a “student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities.”

Twice-exceptional (2E) students: A twice-exceptional (2E) student is defined as “a student who is both gifted and a student with a disability. These students may also be referred to as having dual exceptionalities or as being gifted with learning disabilities (GT/LD). This also applies to students who are gifted with ADHD or gifted with autism” (New Jersey Association for Gifted Children, www.nagc.org).

Instructional adaptation: An adjustment or modification to instruction enabling a student who is gifted and talented to participate in, benefit from, and demonstrate knowledge and application of the New Jersey Student Learning Standards in one or more content areas at the instructional level of the student, not just the student's grade level.

Identifying gifted and talented students: The focus of identification is to provide programming and services in which students' specific learning needs and potential are appropriately addressed and met. In every New Jersey school district, there are students who require modifications to the general education curriculum if they are to achieve in accordance with their abilities. By identifying a student's general intellectual ability, creativity, or specific academic area aptitudes, we are acknowledging that they need programming and services outside of the general education/grade level curriculum to advance their learning.

NJDOE Fast Facts

<https://www.nj.gov/education/standards/gifted/>

<https://www.nj.gov/education/standards/gifted/legislation.shtml>

Supplemental Resources/Programming for Gifted Students

Edward V. Walton

- PETS Program – Primary Education Thinking Skills
- Group Solutions/Group Solutions 2 – Cooperative Logic Activities
- Lollipop Logic
- Beginning Thinking Skills
- AIMS Education Programming

James Caldwell and Thelma L. Sandmeier

Math/ELA

- Project M3: Mentoring Mathematical Minds
- Junior Great Books
- AIMS Education Programming
- Borenson Hands on Equations
- BizWorld
- Perplexors
- Advanced Math Explorations grade 3-5
- Challenging Units for Gifted Learners (ELA and Math)
- Creative Curriculum Extenders
- Differentiated Lessons & Projects
- Challenge Math Grades 4+
- Differentiating Instruction with Menus (All Content Areas)
- Jacob's Ladder
- Genius Hour/Passion Project
- Spatial Reasoning
- Logic Puzzles, Brain Games, Analogies

STEM

- Engineering is Elementary
- Engineer Throughout the Year
- PBS Design Squad
- DefinedSTEM
- Project Lead the Way (PLTW)

Enrichment Events

Experience for all students to be enriched through events related to the curricular or extracurricular activities. Examples include after school clubs, PTA-sponsored events, leadership opportunities, visual and performing arts, and community service opportunities.