



Springfield Public Schools
Springfield, New Jersey

Oceanography
Grade 11 - 12

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

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 1
- 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

(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



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

Springfield Public Schools
Springfield, New Jersey

Rachel Goldberg
Superintendent of Schools

Erica Scudero
Assistant Superintendent of Curriculum and Instruction

Curriculum Developed By:

Dr. Norman Francis ~ Principal of Jonathan Dayton High School

Gregory Salmon ~ STEM Supervisor



Unit Overview Template

Content Area: Oceanography **Grade Level:** 11-12 **Unit Title:** Origins/ Geological Time Periods / Climate Change

Unit Summary: This unit covers the origins of Earth, the sun, and the universe as a whole. It also spans the formation of life on Earth and its evolution. Lastly, it covers Earth's major geological periods and extinctions, as well as the process of climate change and the impact humans have had on its natural cycle. Students will be able to model the creation and expansion of the universe, galaxy, and solar system using software like Stellarium. Students will distinguish theories of life and ocean formation on Earth like seeding from comets and asteroids. Students will explore other planetary systems and compare them to Earth. Students will model the lifespan of stars from their formation, to the fusion of elements and ultimate star fate. Students will create timelines of life's evolution throughout Earth's 4.4 billion year history. Students will also model the effect of thermohaline circulation on global weather systems and the impact that melting ice, fresh-water runoff has had on these warm water currents. Students will sequence climate change, analyze it, and compare the data from modern times to data recorded from ice cores throughout the past 1 million years to understand the similarities and differences in this cycle between now and the past.

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: This unit will allow students to demonstrate proficiency in conducting investigations, analyzing data, using mathematics and statistics to support claims, and applying scientific ideas to solve problems and to use these practices to demonstrate understanding of the core ideas.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 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.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 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.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.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
- 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.

Learning Targets

Standards: HS-ESS1, HS-ESS2, HS-ESS3, HS-LS4

Content Statements: Earth's Place in the Universe; Earth's System; Earth and Human Activity ; Biological Evolution: Unity and Diversity

CPI#: **Cumulative Progress Indicator (CPI):**

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-ESS1-2	Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.
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-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
HS-ESS3-1	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.



HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-5	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's systems.
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-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
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.
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.2	Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
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.
8.2.12.EC.1	Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
8.2.12.EC.2	Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.

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 world(s).

- *Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS1-1), (HS-ESS2-1), (HS-ESS2-3)*
- *Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4)*

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.

- *Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (HS-ESS1-6)*

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 scientific or historical episodes in science.

- *Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5)*
- *Construct an oral and written argument or counter-arguments based on data and evidence. (HS-ESS2-7)*

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 ideas (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-ESS1-3)*

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.

- *Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5)*

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.

- *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)*
- *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 knowledge, 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-ESS1-2), (HS-ESS3-1), (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):

ESS1.A: The Universe and Its Stars

- *The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1)*
- *The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2), (HS-ESS1-3)*
- *The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2)*
- *Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2), (HS-ESS1-3)*

ESS1.B: Earth and the Solar System

- *Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have*



altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4)

ESS1.C: The History of Planet Earth

- *Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. (HS-ESS1-5)*
- *Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6)*

ESS2.A: Earth Materials and Systems

- *Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1)*
- *Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3)*
- *The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)*

ESS2.B: Plate Tectonics and LargeScale System Interactions

- *The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. (HS-ESS2-3)*
- *Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. (HS-ESS2-1), (secondary to HS-ESS1-5)*

ESS2.D: Weather and Climate

- *The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's reradiation into space. (HS-ESS2-4)*
- *Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-7)*
- *Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4)*



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.B: Natural Hazards

- *Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)*

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

- *Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)*
- *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)*

PS1.C: Nuclear Processes

- *Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HS-ESS1-5), (secondary to HS-ESS1-6)*

PS3.D: Energy in Chemical Processes and Everyday Life

- *Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to HS-ESS1-1)*

PS4.A: Wave Properties

- *Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. (secondary to HS-ESS2-3)*

PS4.B Electromagnetic Radiation

- *Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2)*

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.C: Adaptation

- 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-LS4-4)
- 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)

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

- Empirical evidence is needed to identify patterns. (HS-ESS1-5)
- 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)



Scale, Proportion, and Quantity

- *The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1)*

Energy and Matter

- *Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. (HS-ESS1-2)*
- *In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-ESS1-3)*

Stability and Change

- *Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS1-6)*
- *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), (HS-ESS3-5)*

Cause and Effect

- *Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1), (HS-LS4-4), (HS-LS4-5), (HS-LS4-6)*

Systems and System Models

- *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)*

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- *Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HS-ESS1-2)*

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

- *Modern civilization depends on major technological systems. (HS-ESS3-1), (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)*

Scientific Investigations Use a Variety of Methods



- *Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5)*
- *New technologies advance scientific knowledge. (HS-ESS3-5)*

Scientific Knowledge is Based on Empirical Evidence

- *Science knowledge is based on empirical evidence. (HS-ESS3-5)*
- *Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS3-5)*

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-ESS1-2), (HS-LS4-1), (HS-LS4-4)*
- *Science assumes the universe is a vast single system in which basic laws are consistent. (HS-ESS1-2)*

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:

- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years.
- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.
- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gasses, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.
- Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old.
- Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history.
- Plate Tectonics and Large-Scale System Interactions Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geological history.



- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere.

Unit Enduring Understandings:

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
- Empirical evidence is needed to identify patterns.
- 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).
- Energy cannot be created or destroyed— only moved between one place and another place, between objects and/or fields, or between systems.
- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.
- Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable.
- Energy drives the cycling of matter within and between systems.
- Much of science deals with constructing explanations of how things change and how they remain stable.
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Feedback (negative or positive) can stabilize or destabilize a system.
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- 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.
- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- Modern civilization depends on major technological systems.

Unit Learning Targets:

Students will....

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
- Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.



- Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.
- Communicate scientific ideas (c.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).
- 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 (c.g., number of trials, cost, risk, time), and refine the design accordingly.
- Construct an oral and written argument or counter-arguments based on data and evidence.
- Analyze data using computational models in order to make valid and reliable scientific claims.
- Create a computational model or simulation of a phenomenon, designed device, process, or system.
- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations.



Evidence of Learning

Summative Assessment: 40 days

Equipment Needed: Computers, Internet Access

Teacher Stellarium Program

Resources: BBC Nature: History of Life on Earth
National Geographic: What if all ice on Earth melted?
NASA: Climate and Weather
“Life After People” Documentary
Kahoot Assessment Software
Socrative Assessment Software

Formative Assessments:

- Stellarium Star Hunt
- HR-Diagram Investigation
- Origins of Earth / Solar Systems Kahoot and Socrative
- Origins of Life Timeline
- Earth’s Major Geological Periods and Extinctions
- Geological Time Periods Kahoot and Socrative
- James Balog TED Talk Questionnaire
- Climate Change / Equilibrium Kahoot and Socrative
- Future Sunken City Project



Lesson Plans

Lesson	Time Frame
Lesson 1 Stellarium Star Investigation	3-4 hours/ 4-5 days
Lesson 2 Origins of Life	1.5 hours/ 2 days
Lesson 3 Thermohaline Circulation and CO₂	4-5 hours/ 5-6 days

Teacher Notes:

These three lessons represent the major ideas in this unit. Stellarium Star investigation has students use the program Stellarium to analyze real-life stars using the HR-Diagram. Students then compare other stars to our own, and learn about the origins of our galaxy, solar system, and planet. The Origins of Life lesson discusses different theories of life's formation on Earth like seeding. Students then construct timelines modeling the evolution of life throughout Earth's 4.4 billion year history, and learn about Earth's past geological periods and major extinctions. Lastly, students learn about Earth's dynamic processes to maintain equilibrium. The Thermohaline circulation and CO₂ lesson uses resources from NASA's website to model the flow of ocean currents and the effect that melting ice, fresh-water has on warm, salt-water currents. Students then learn the sequence of the climate cycle, and climate change as a whole. The future sunken city project is an end of unit project where students research coastal cities in danger of flooding from rising sea levels. Students will evaluate causes, costs, and potential solutions and produce formal proposals for each city. This is a comprehensive project taking all the unit's concepts into consideration.

Curriculum Development Resources/Technology Resources:

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

http://www.bbc.co.uk/nature/history_of_the_Earth

<https://pmm.nasa.gov/education/weather-climate>

https://www.ted.com/talks/james_balog_time_lapse_proof_of_extreme_ice_loss

<https://www.nationalgeographic.com/magazine/2013/09/rising-seas-ice-melt-new-shoreline-maps/>

<https://socrative.com/>

<https://kahoot.com/>



Lesson Plan 1 Template

Content Area: Oceanography	Lesson Title: Stellarium Star Investigation	Time Frame: 3-4 hours/4-5 days
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Lesson Components

21st Century Themes

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| ☒ 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 running the Stellarium planetarium software application to track real-time celestial motion, zoom into active stellar nurseries, and analyze stellar spectral profiles.
- Socrative and Kahoot interactive assessment applications deployed via iPad for automated, real-time cosmic timeline verification and structural astronomy checks.
- Cloud-based collaborative spreadsheets to pool student star data (apparent magnitude, absolute magnitude, B-V color index) directly into a digital Hertzsprung-Russell template.

Equipment Needed:

- Student iPads with internet access and the Stellarium application pre-loaded.
- High-definition classroom projection system for displaying stellar evolution models.
- Spectroscope prisms or diffraction grating glasses paired with gas-discharge tubes (Hydrogen, Helium, Oxygen) to model chemical emission lines.
- Scale-model accretion manipulative kits (varying density polymer spheres and magnetic orbital trays).

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Model star life cycles, charting the evolutionary paths of low-mass stars versus high-mass stars on a Hertzsprung-Russell diagram. - Analyze real-life stars using digital planetarium software to determine how a star's surface temperature correlates with its observed	Lesson Sequence: Cosmic Origins Phenomenon & Essential Question: The teacher projects spectroscopic lines of ocean water components alongside the essential question: <i>"How did the universe, our solar system, and Earth's oceans form?"</i> Students analyze how early universal matter lacked	Stellarium Observation Log & Star Hunt Worksheet: A completed digital tracking matrix documenting coordinates, spectral colors, temperatures, and developmental stages for at least six



spectral color and luminosity.

- Forecast the fate of our sun, mapping its transition from a main-sequence star into a red giant and its ultimate collapse into a white dwarf.
- Model the creation of Earth and its oceans, tracing how gravitational accretion and volcanic outgassing accumulated the planet's internal layers and early hydrosphere.

heavy elements, generating a baseline discussion on cosmic origins.

2. Stellar Nucleosynthesis Benchmark Lesson: The teacher delivers a mini-lecture mapping the Big Bang Theory, subatomic particle formation, and the Nebular Hypothesis. Students use diffraction grating glasses to observe gas-discharge tubes, taking structured digital notes on how stellar nucleosynthesis cooks lighter hydrogen and helium into heavier elements like oxygen and iron.
3. Stellarium Digital Star Hunt & Spectrum Lab: Students launch the Stellarium application on their iPads. They hunt for specific real-world stars (such as Betelgeuse, Rigel, and Sirius), recording their apparent brightness, color variations, and distances, using their iPads to capture screenshots of the data fields.
4. HR Diagram Digital Graphing Investigation: Using the star data harvested from Stellarium, student pairs input their metrics into a shared cloud spreadsheet. The software auto-generates a digital Hertzsprung-Russell (H-R) diagram, and students trace where our Sun sits

target stars with zero identification errors.

- Collaborative H-R Diagram Mapping File: A accurately plotted star chart matching brightness against color indices, verifying student understanding of main sequence lifecycles.
- Socrative & Kahoot Origins Checkpoint: Automated electronic data readouts evaluating individual student comprehension of the Nebular Hypothesis, accretion metrics, and planetary differentiation.
- Cosmic Water CER Synthesis Document: A written Claim-Evidence-Reasoning response detailing how volcanic outgassing and comet impacts formed the early hydrosphere, backed by raw elemental evidence.
- Students will define stellar nucleosynthesis as the structural process by which nuclear fusion reactions inside stars create heavier atomic



- | | | |
|--|---|---|
| | <p>relative to high-mass supergiants, predicting its future structural collapse.</p> <p>5. Accretion and Planetary Layering Modeling: Transitioning from stars to planets, students manipulate scale-model orbital trays to simulate the Nebular Hypothesis. They model how gravitational attraction drives accretion, how impact energy generates heat, and how planetary differentiation separates Earth's heavy iron core from its lighter mantle.</p> <p>6. Hydrosphere Sequencing Activity & Choice Project: Students organize a structural sequencing card sort on their iPads, tracing the origin of ocean water from planetary accretion, through intense volcanic outgassing of water vapor, to the cooling and condensation that triggered centuries of torrential rain. The lesson culminates in a short, student-selected digital timeline or infographic showing the link between cosmic star death and the origin of Earth's marine environment, verified by a quick Socrative exit quiz.</p> | <p>nuclei from lighter ones.</p> <ul style="list-style-type: none">• Students will correctly identify volcanic outgassing as the primary geological mechanism responsible for releasing massive amounts of water vapor into early Earth's atmosphere on an exit ticket. |
|--|---|---|

Differentiation:

- Representation and Product Choice: Following all active 504 and IEP accommodations, students choose to display their mastery by creating a digital infographic, a video-recorded planetarium tour narration, or a handwritten, highly illustrated tactile timeline log.



- Multi-Sensory Media Scaffolding: Pre-bordered diagram templates, color-coded chemical emission keys, and simplified bulleted vocabulary decks are pre-loaded onto student iPads to support diverse cognitive processing pathways.
- Task Customization Tracks: Students are granted the structural choice to complete laboratory matching sheets independently or with a designated peer partner, setting their own milestone benchmarks within a student-driven daily timeline.
- Advanced students can use their iPads to calculate gravitational potential energy transfers during accretion phases, modeling how kinetic impacts dictate the thermal melting point of primitive planetary rock layers.
- Structured sentence frames are built directly into the tracking software interfaces: When a massive star runs out of fuel and explodes, it scatters heavy elements like [blank] into space, which later accumulate into a spinning solar nebula that condenses through the process of gravitational [blank] to form rocky planets.

Resources Provided:

- Digital oceanography and astronomy textbook materials, interactive Stellarium links, and curated video clips detailing solar system formation.
- Core Astronomy Pack (H-R diagram coordinates, star hunt search parameters, outgassing data charts, and CER writing templates).
- iPads, diffraction gratings, gas-discharge equipment arrays, and physical density sorting spheres.



Lesson Plan 2 Template

Content Area: Oceanography Lesson Title: Origins of Life Time Frame: 1.5 hours/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: Environmental Science

Integration of Technology:

- Stellarium application
- Student iPads running interactive Nearpod slide decks to explore high-resolution 3D macro-reconstructions of hydrothermal vent ecosystems and primordial Earth matrices.
- Socrative and Kahoot interactive review systems used via iPad to run real-time milestone checks and automated chronological sequencing updates.
- Cloud-based interactive timeline software (such as digital layout programs) to build and share multi-axis evolutionary pathways tracking Earth's 4.4-billion-year timeline.

Equipment Needed:

- Student iPads for running digital timeline applications, taking notes, and participating in Socrative polls.
- Classroom projection system linked to an interactive electronic whiteboard display.
- Pre-cut, heavy-duty tactile sequencing card sets representing deep-time geological eras and evolutionary milestones.
- Authentic or museum-grade replica fossilized stromatolite cross-sections.
- Multi-colored molecular modeling manipulative kits (representing carbon, hydrogen, oxygen, nitrogen, and phosphorus atoms).

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Model the formation of Life on Earth, simulating how basic inorganic gases assemble into complex organic compounds like amino acids under	Lesson Sequence: 1. Early Earth Conditions Phenomenon & Essential Question: The teacher displays a micro-photo of a 3.5-billion-year-old	• Origins of Life Scaled Timeline: A finalized digital or physical chronology tracking Earth's 4.4-billion-year history, mapping all



primitive atmospheric conditions. - Sequence the Steps of Evolution, arranging key biological shifts—from the first anaerobic prokaryotes to multicellular marine organisms—in correct physiological order. - Produce a timeline of evolution for Earth's 4.4-billion-year history, calculating relative scale distances to visually map deep-time intervals.	stromatolite alongside the essential question: <i>"How did life originate on Earth?"</i> Students analyze the extreme conditions of early oceans, triggering a collaborative debate on abiogenesis and panspermia pathways. - Theoretical Underpinnings Benchmark Lesson: The teacher delivers a mini-lecture covering major scientific theories for the origin of life, including the Primordial Soup Hypothesis, the Miller-Urey experiment, Hydrothermal Vent Theory, and the Theory of Seeding (Panspermia). Students use their iPads to take structured digital notes on how environmental energy drives chemical evolution. - Primary Compound Molecular Modeling Lab: Working in biochemistry pairs, students use molecular modeling kits to build simple molecules present on early Earth (methane, ammonia, water vapor). They physically manipulate the bonds to simulate how these simple units combine to form complex organic	major biological transitions with no placement errors. - Molecular Synthesis Data Sheet: A completed modeling worksheet featuring accurate structural diagrams showing the transformation from inorganic compounds to basic organic building blocks. - Socrative & Kahoot Evolution Checkpoints: Electronic performance profiles capturing student accuracy regarding primitive atmospheric conditions and early cell developments. - Theoretical Evaluation CER Response: A written forensic argument evaluating the validity of origin theories using fossil, chemical, and astronomical data as evidence. - Students will define abiogenesis as the natural process by which life arises from non-living matter, such as simple organic compounds. - Students will correctly identify anaerobic prokaryotes as the first type of single-celled organisms to emerge within early Earth's primitive,
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	monomers like amino acids and nucleotides, using their iPads to document the structural changes. 4. Deep-Time Evolutionary Chronology Sort: Student teams transition to a hands-on sequencing challenge using tactile card decks. They collaborate to arrange major evolutionary milestones—ranging from the formation of the crust and oceans, through the appearance of the first single-celled cyanobacteria and the Great Oxidation Event, to the explosion of complex multicellular eukaryotes—verifying their placements via an intermediate Kahoot checkpoint. 5. Digital 4.4-Billion-Year Timeline Construction: Moving to their iPads, students use historical resources (such as digital Earth archives) to build a formal, to-scale chronological evolutionary timeline. They map out eras, inputting descriptions of the chemical and biological transitions that allowed life to survive and evolve across massive	oxygen-depleted marine environments on an exit ticket.
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- geographical time scales.
6. Claim-Evidence-Reasoning (CER) Evaluation & Socratic Review:
Teams analyze a packet of raw scientific evidence (meteorite amino acid assays, deep-sea chemosynthetic bacteria profiles, and ancient rock isotopes) to write a digital CER paper defending which origin theory is best supported by current data. The lesson concludes with an individual Socratic quiz to verify student mastery of early planetary timelines.

Differentiation:

- Representation and Material Choice: Following all active 504 and IEP accommodations, students are given the choice to construct a digital infographic, draw a multi-panel science comic strip, build a 3D physical layout, or complete a structured handwritten timeline log.
- Multi-Sensory Data Scaffolding: Pre-bordered chronological frameworks, color-matched molecular assembly keys, and simplified bulleted vocabulary decks are pre-loaded into student iPads to assist with text-dense processing barriers.
- Variable Group Configurations: Students maintain the explicit daily choice to complete experimental analysis sheets independently or with a designated lab partner, tracking milestones along a student-managed daily timeline.
- Advanced students can use their iPads to research the iron-sulfur world hypothesis, charting how early metabolic pathways could function along the crystal lattices of deep-sea hydrothermal mineral vents.
- Structured sentence frames are built directly into the tracking software templates: According to the Primordial Soup Hypothesis, early atmospheric gases were struck by energy from lightning or UV radiation, forcing them to synthesize into organic molecules like [blank], which later organized into the first living [blank] cells in the ancient oceans.

Resources Provided:

- History of Life video
- Digital oceanography, biochemistry, and historical geology text chapters, along with curated media links detailing evolutionary milestones.



- Core Origins Pack (Miller-Urey diagram keys, geological time scale matrices, CER argument outlines, and project criteria rubrics).
- iPads, anatomical fossil replicas, multi-element molecular building sets, and tactile sequencing arrays.



Lesson Plan 3 Template

Content Area: Oceanography	Lesson Title: Thermohaline Circulation and Co ₂	Time Frame: 4-5 hours/ 5-6 days
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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 utilizing real-time global climate dashboards (such as NASA's Vital Signs of the Planet) to track atmospheric carbon dioxide concentrations and historical sea surface temperature anomalies.
- Socrative and Kahoot interactive polling applications deployed via iPad to gauge student mastery of density variables and carbon cycling vectors.
- Cloud-based collaborative graphing platforms to chart and extrapolate multi-axis climate trends from the Industrial Revolution to the present day.

Equipment Needed:

- Student iPads with high-speed internet access.
- Classroom projection system linked to an interactive mapping display.
- Clear acrylic dual-zone current tank models or clear plastic shoe boxes with central removable dividers.
- Liquid food coloring packs (red and blue).
- Concentrated saline solutions, chilled freshwater ice water packs, and heated freshwater water reservoirs.
- Precision digital hydrometers or handheld salinity refractometers.

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Model the transfer of heat using thermohaline circulation, manipulating	Lesson Sequence Climate Regulation Phenomenon & Driving Question: The teacher	Thermohaline Lab Observation & Refractometer Matrix: A



fluid temperature and salinity gradients to drive convective sinking currents.

- Sequence the steps of climate change, mapping out the cascade from anthropogenic emissions to ocean warming, glacial ablation, and current deceleration.
- Analyze human effect on the natural CO₂ cycle, evaluating how fossil fuel combustion drives ocean acidification and thermal expansion.

projects global satellite sea-surface temperature maps alongside the driving question: *"How do oceans help regulate Earth's climate?"* Students analyze how localized current variations distribute equatorial heat toward the poles, establishing a baseline diagnostic discussion.

2. Density Mechanics & Heat Transport
Benchmark Lesson: The teacher delivers a targeted lecture breaking down the global ocean conveyor belt, deep-water formation zones (like the North Atlantic Deep Water), and the physics of thermohaline circulation. Students use their iPads to take structured digital notes on how salinity and temperature dictate fluid density.
3. Tactile Thermohaline Circulation Laboratory: Working in oceanographic research pairs, students use clear current tank models to simulate deep-ocean movement. They fill one side with cold, highly saline water colored blue, and the other with warm, fresh water colored red; upon lifting the central divider, they observe and

finalized laboratory sheet detailing fluid density measurements, current direction illustrations, and written explanations of salinity-driven sinking mechanisms.

- Multi-Axis Climate Graph & Data Export: An accurately plotted line chart matching historical carbon dioxide increases with sea surface temperature anomalies, free of scaling errors.
- Future Sunken City Presentation Document: A student-selected digital infographic or public awareness layout mapping how current deceleration and melting ice change specific global coastal boundaries.
- Socrative & Kahoot Climate Checkpoints: Electronic performance profiles tracking student accuracy regarding greenhouse gas sinks, conveyor belt mechanics, and density changes.
- Students will define thermohaline circulation as the large-scale, density-driven deep ocean circulation system determined by gradients of temperature and salinity.
- Students will correctly identify the melting of terrestrial glaciers as the primary source of



	record how the dense blue water drops and flows beneath the buoyant red layer, measuring density spikes using handheld refractometers. 4. Multi-Axis Climate Data Analysis: Transitioning to their iPads, students access historical climate databases (including NASA and National Geographic datasets). They analyze atmospheric carbon dioxide levels alongside global sea surface temperatures since the Industrial Revolution, constructing comparative line charts to identify mathematical correlations between gas concentrations and thermal changes. 5. Anthropogenic Feedback Loop Sequencing Sort: Using data from climate resources like James Balog's ice monitoring logs, student groups complete a digital sequencing activity on their iPads. They arrange the cause-and-effect steps of modern climate disruption: carbon emissions elevate atmospheric insulation, rising temperatures drive rapid melting of terrestrial glaciers, and the resulting influx of	low-salinity freshwater that can block subpolar sinking currents on an end-of-class response voucher.
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- fresh water dilutes ocean salinity, blocking the thermohaline conveyor belt.
6. Future Sunken City Project & Evaluation: Working individually or in teams, students execute a "Future Sunken City" case study. They use interactive coastal risk maps to evaluate how sea-level rise and current stagnation threaten a real-world coastal metropolis, synthesizing their findings into a digital infographic or climate model before completing a final Socratic exit ticket.

Differentiation:

- Modality and Product Representation Choice: Following all active 504 and IEP accommodations, students choose to display their understanding by building a digital infographic, designing a public awareness climate poster, constructing a 3D physical modeling layout, or writing a structured handwritten lab report.
- Sensory Data and Vocabulary Scaffolding: Pre-bordered coordinate graph systems, color-coded current flow charts, and simplified bulleted vocabulary decks are pre-loaded onto student iPads to support teams managing text-dense or visual processing friction.
- Individual and Collaborative Tracks: Students maintain the explicit daily choice to run data tracking sheets independently or split laboratory duties alongside a designated partner, pacing their milestones via a student-managed daily timeline.
- Advanced students can use their iPads to calculate the volumetric rate of freshwater influx required to stop a localized sinking zone, modeling current speed drops over decades.
- Structured sentence frames are built directly into the lab documentation templates: As human activities release excess carbon dioxide into the atmosphere, the oceans absorb trapped heat, causing polar glaciers to melt and dump low-density [blank] water into the sea, which lowers the overall [blank] and slows down the global thermohaline conveyor belt.

Resources Provided:

- Digital oceanography textbooks, interactive NASA climate data ports, and National Geographic shoreline mapping archives.
- Core Climate Pack (Thermohaline tank blueprints, carbon cycle flowcharts, sea-level prediction matrices, and infographic design rubrics).
- iPads, acrylic current boxes, food color packs, salt mixtures, and precision refractometers.



- National Geographic:
<https://www.nationalgeographic.com/magazine/2013/09/rising-seas-ice-melt-new-shoreline-maps/>
- NASA Thermohaline Circulation
<https://pmm.nasa.gov/education/weather-climate>
- James Balog Ice Blog:
https://www.ted.com/talks/james_balogs_time_lapse_proof_of_extreme_ice_loss



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

Curriculum Design Template

Content Area: Oceanography	Grade Level: 11-12	Unit Title: Origins / Geological Periods / Climate Change
Created: 2026	Board Approved on:	Type Here



Unit Overview Template

Content Area: Oceanography **Grade Level:** 11-12 **Unit Title:** Life in the Ocean and Communities

Unit Summary: This Unit explores the connection between the biotic and abiotic elements of the ocean and identifies different living communities based at the surface, bottom and mid depth regions of the ocean.

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: This unit ties together living elements from Biology with nonliving inputs like light and heat from Physics and Chemistry.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 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.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 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.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.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
- 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.



Learning Targets

Standards: HS-LS1; HS-LS2

Content Statements: From Molecules to Organisms: Structures and Processes; Types of Interactions between living creatures

CPI#: **Cumulative Progress Indicator (CPI):**

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-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.
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.2	Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
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.
8.2.12.EC.1	Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
8.2.12.EC.2	Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.

Science and Engineering Practices:

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)*

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 representations of phenomena or design solutions to support claims. (HS-LS2-4)*

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)*

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)*

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)*



Crosscutting Concepts:

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)

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)

Energy and Matter

- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS2-4)
- Energy drives the cycling of matter within and between systems. (HS-LS2-3)

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-LS2-3)

Unit Essential Questions

- How does structure denote function in marine organisms?
- How does matter and energy cycle in the ocean?
- What is the role of photosynthesis in the ocean?
- Resource availability has guided the development of human society.
- Natural hazards and other geologic events have shaped the course of human history; they have significantly altered the sizes of human populations and have driven human migrations.
- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
- 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.
- 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.
- 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.

Unit Enduring Understandings:

- 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.
- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
- Empirical evidence is needed to identify patterns.
- 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).
- Energy cannot be created or destroyed— only moved between one place and another place, between objects and/or fields, or between systems.

Unit Learning Targets:

- Students will understand how form and function are tied together, and how genetically unrelated species can evolve similar form in similar environments.
- Students will also understand how energy cycles in the marine environment and how materials accumulate at the various trophic levels. Furthermore, students will be able to apply their knowledge to modify eating patterns to minimize exposure to dangerous chemicals that accumulate in the food chain.
- 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.
- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations.
- 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).
- 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.



Evidence of Learning

Summative Assessment: 25 days

Equipment Needed: Textbook, lab materials

Teacher: Laptop, textbook

Resources:

Formative Assessments:

- How does the structure of the barnacle's shell aid in its function?
- How does the swim bladder composition help the fish stay at neutral buoyancy?
- Describe the energy transfer in an energy pyramid rising through the layers.
- What happens to indigestible nutrients like lead as you travel up the food chain?



Lesson Plans

Lesson	Time Frame
Lesson 1 How form follows function in the Ocean	4 days
Lesson 2 Follow the Energy	3 days
Lesson 3 Bioaccumulation of methylated mercury	2 days

Teacher Notes:

Do not rely solely on textbook diagrams of marine invertebrates. Having a student physically touch a barnacle's stone-hard calcite plates and pull out the microscopic, jointed chitinous feeding legs forces them to confront the reality of adaptation. They instantly see why a sessile animal needs armor and fans, whereas a pelagic fish needs sleek lines and streamlined sensory channels.

Curriculum Development Resources/Technology Resources:

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

Anatomy form and function

www.elasmo-research.org/education/white_shark/anatomy.htm

Trophic levels in the ocean

<https://study.com/academy/lesson/ocean-energy-pyramid.html>

Bioaccumulation in Oceans

<https://www.scientificamerican.com/article/how-does-mercury-get-into/>



Lesson Plan 1 template

Content Area: Oceanography Lesson Title: How form follows function in the ocean 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 running interactive Nearpod units to manipulate high-resolution 3D digital scans of diverse marine skeletal structures and fin geometries.
- Digital interactive response networks deployed via iPad to manage real-time structural diagnostic check-ins and morphological vocabulary matches.
- Cloud-based collaborative spreadsheets to log and graph Reynolds numbers or fluid drag coefficients calculated during hands-on hydrodynamic trials.

Equipment Needed:

- Student iPads for data tracking, digital note-taking, and running interactive assessments.
- Dissection trays, fine forceps, dissecting needles, surgical scissors, and safety scalpels.
- Preserved specimen sets or fresh seafood market samples of barnacles (*Balanus*) and standard bony fish (e.g., perch or mackerel).
- Clear, vertical plastic acrylic flow tubes or graduated cylinders filled with high-viscosity fluids (mineral oil, glycerin, water).
- Variety of clay shapes modeling diverse marine body forms (fusiform/torpedo, compressed, depressed, attenuated).
- Handheld magnifying loupes or stereomicroscopes.

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Understand how form follows function in the marine environment, analyzing how specific structural adaptations (such as gills, swim bladders, and fin designs)	Lesson Sequence 1. Hydrodynamic Phenomenon & Driving Question: The teacher projects side-by-side skeletal silhouettes of a shark, an ichthyosaur, and a dolphin	• Morphological Dissection Data Portfolio: A fully executed lab manual featuring annotated structural drawings of



directly resolve spatial survival challenges. • Comprehend how similar environments could create similar solutions in unrelated species, evaluating the biomechanical constraints that drive convergent evolution. • Break down the mechanisms of natural selection in the marine environment, explaining how selective pressures like water density, visibility, and drag filter random phenotypic variations.	alongside the driving question: <i>"How does the physical physics of fluid density dictate the shapes of marine life?"</i> Students analyze the anatomical similarities, logging their convergent evolution claims on a Nearpod collaboration board. 2. Marine Biomechanics Benchmark Lesson: The teacher delivers a mini-lecture focused on ocean zones, fluid friction, and natural selection pressures. Students take structured digital notes detailing how water's high density and viscosity forces marine species to evolve specialized swimming, respiration, and feeding structures to optimize energy output. 3. Hands-on Hydrodynamic Drag Simulation: Working in physics-of-life pairs, students mold equal masses of modeling clay into distinct marine body geometries: fusiform (tuna), laterally compressed (angelfish), and depressed (flounder). They drop each shape down clear vertical flow tubes filled with fluid, using their iPads to record video and calculate terminal velocities, mapping which specific geometry minimizes drag friction. 4. Comparative Macro-Anatomical Lab	barnacle cirri and fish gill arches, with each structure explicitly paired with its mechanical survival function. • Hydrodynamic Drag Lab Record Sheet: An accurately tracked data sheet containing terminal drop times, velocity calculations, and geometric shape comparisons with no mathematical errors. • Socrative Evolution Diagnostic Profile: Real-time digital performance summaries tracking individual student comprehension of selective pressures, natural selection, and convergent traits. • Students will define convergent evolution as the independent evolution of similar structural features in species of different lineages due to similar environmental pressures. • Students will correctly identify the feathery cirri of a barnacle as an adaptive structural form optimized specifically for sessile filter-feeding within high-energy current zones on an
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	(Barnacle vs. Fish): Teams transition into an active comparative structural lab. Using magnifying glasses and dissection tools, they examine a sessile barnacle, isolating its calcified shell plates and specialized feathery appendages (cirri) used to filter feed in high-energy intertidal wave zones. They contrast this against a mobile bony fish specimen, dissecting and examining its gills, lateral line system, and fin configurations to map out structural locomotion vectors. 5. Video Synthesis Observation: Students view selected underwater macro-footage (such as clips from the BBC Life or Blue Planet series) focusing on specialized marine survival mechanisms. They complete a digital video questionnaire analyzing how changing environmental contexts (pelagic open ocean vs. benthic seafloor) cause natural selection to favor wildly divergent anatomical forms. 6. Evidence-Based Evolution Write-Up & Socratic Exit Card: Students combine their drag lab measurements, dissection data, and video observations to compose a brief scientific argument defining how physical environments limit	end-of-class response voucher.
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structural design. The lesson wraps up with an individual Socratic diagnostic quiz to confirm student mastery of convergent evolution mechanisms.

Differentiation:

- Representation and Expression Freedom: Following all individual 504 and IEP accommodations, students are given the choice to present their morphological mastery by building a digital structural infographic, creating a labeled video narration of their dissection, mapping a physical data layout, or writing a traditional handwritten lab notebook log.
- Multi-Sensory Scaffolding and Media Files: Pre-contoured drawing frameworks, color-coded anatomical identification keys, and simplified bulleted vocabulary decks are pre-loaded into student iPads to assist with fine-motor or processing barriers.
- Customized Workspace Configurations: Students maintain the explicit structural choice to execute dissecting and drop-tube testing tasks independently or collaborate alongside a designated lab partner, pacing their daily work using a student-managed timeline.
- Advanced students can use their iPads to calculate localized surface-area-to-volume ratios (SA/V) of cold-water marine organisms, modeling how geometric scale dictates heat conservation and oxygen diffusion efficiency in polar ecosystems.
- Structured sentence frames are built directly into the lab documentation templates: The fusiform body shape of a bluefin tuna is a structural adaptation that lowers fluid [blank] in the open ocean, which serves as a prime example of [blank] evolution because this exact same shape is found in unrelated marine mammals who face identical natural selection pressures.

Resources Provided:

- Digital marine biology textbook chapters (Garrison), interactive 3D anatomy archives, and high-resolution video streams.
- Core Morphology Pack (Dissection guide lines, hydrodynamic velocity data matrices, convergent evolution mapping charts, and report rubrics).
- Dissection trays and kits, preserved/fresh barnacle and fish samples, acrylic drop tubes, testing fluids, and modeling clays.



Lesson Plan 2 Template

Content Area: Oceanography Lesson Title: Follow the Energy 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:

- Student iPads running interactive Nearpod slide decks to trace metabolic heat losses and manipulate digital ecosystem food webs.
- Digital interactive software utilized via iPad to conduct real-time mathematical biomass checks and energy rule calculations.
- Shared cloud-based spreadsheets to simulate population shifts and trace ecological imbalances caused by apex predator removal.

Equipment Needed:

- Student iPads for running interactive activities, graphing biomass data, and tracking notes.
- Precision digital scales, weighing boats, and fine forceps.
- Graduated cylinders, multi-colored balancing tokens, and customized paper trophic pyramid folding templates with scissors.
- Prepared biological slides of marine diatoms, dinoflagellates, and copepods paired with compound light microscopes.
- Preserved or fresh market specimens of a lower-trophic forage fish (e.g., sardine or anchovy) to analyze gill rakers and stomach contents.

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Understand how energy flows within an ecosystem, tracking solar radiation transfers from autotrophic phytoplankton through	Lesson Sequence 1. Phenomenon: An oceanographic survey across a 1,000-square-kilometer pelagic zone captures and logs millions of metric tons of microscopic	• Trophic Pyramid Laboratory Log & Assembly Model: A completed 3D paper pyramid model and data sheet featuring accurate 10% reduction math



multiple heterotrophic consumer pathways. • Comprehend the decrease in biomass within a trophic level, explaining how the Second Law of Thermodynamics dictates a massive metabolic heat loss at each ecological step. • Apply the trophic principle to make environmentally sound food selections, evaluating the ecological efficiency and lower environmental footprint of consuming lower-trophic marine resources.	marine phytoplankton, but records only a few thousand total tons of small schooling sardines, and just three individual apex great white sharks inhabiting the exact same surface waters. 2. Biomass Disparity Phenomenon & Driving Question: The teacher displays a visual biomass breakdown chart of the open ocean alongside the driving question: <i>"Why are there millions of sardines but only a handful of sharks?"</i> Students debate the energetic barriers limiting apex populations, logging their hypotheses on the Nearpod collaboration board. 3. Thermodynamic Trophic Efficiency Benchmark Lesson: The teacher delivers a mini-lecture on primary productivity, metabolic cellular respiration, and the 10% Rule of ecological energy transfer. Students take structured digital notes mapping how 90% of consumed energy is lost as metabolic heat or undigested waste, restricting the height of marine food chains. 4. Microscopic Primary Producer Observation: Pairs configure their	tracking calories and mass across four distinct ecological tiers. • Phytoplankton & Gill Raker Micro-Anatomy Log: Labeled structural sketches and annotations connecting the surface area of primary producers and specialized fish gill rakers to efficient energy extraction. • Socratic Trophic Efficiency Checkpoint: Automated electronic data files assessing individual student proficiency in thermodynamic laws, trophic level categorization, and community biomass calculations. • Anthropogenic Dietary Evaluation Form: A short written analysis evaluating the environmental trade-offs of commercial apex harvesting, using caloric calculations to recommend sustainable seafood consumption. • Students will define the 10% rule as the ecological principle stating that only about ten percent of the energy available at one trophic level is transferred efficiently to the next level. • Students will correctly identify metabolic heat loss through cellular
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	compound microscopes to observe slides of marine diatoms and dinoflagellates. They sketch these base-tier autotrophs and analyze how solar capture drives open-ocean primary productivity, linking cellular light harvesting to the creation of all marine biomass. 5. Tactile 10% Efficiency Modeling Lab: Using colored tokens representing raw kilocalories, student teams model energy transfer through a four-tier food chain. They start with 10,000 calories at the producer level and physically count out and discard 90% of the tokens at each subsequent step (transferring 1,000 to zooplankton, 100 to sardines, and just 10 to a predatory tuna), assembling a folded 3D paper pyramid model to visualize this steep depletion. 6. Forage Fish Trophic Anatomy Dissection: Teams transition to a physical observation of a lower-trophic specimen (sardine or anchovy). They use dissecting tools to expose the gills, analyzing the fine, comb-like structure of the gill rakers used to strain	respiration as the primary mechanism responsible for the rapid decrease of energy across ascending trophic levels on an exit ticket.
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- microscopic plankton directly from the water column, and log how this direct feeding link bypasses intermediate energy losses.
7. **Anthropogenic Trophic Choice Analysis & Socratic Review:** Students use their iPads to analyze data charts tracking global commercial fisheries, overfishing patterns, and ocean tracking indexes. They calculate the total ecological energy cost required to produce one pound of apex swordfish versus one pound of primary consumer sardines, drafting a short argument explaining how target consumer choices change marine ecosystem stability. The session concludes with a Socratic exit quiz verifying trophic math skills.

Differentiation:

- **Representation and Synthesis Freedom:** Following all active 504 and IEP accommodations, students can demonstrate conceptual mastery by creating an interactive digital food web, designing a seafood sustainability infographic, assembling a 3D tactile community matrix, or formatting a traditional handwritten lab journal entry.
- **Multi-Sensory Scaffolding and Media Arrays:** Pre-scaled calculation templates, color-coded energy transfer keys, and simplified bulleted vocabulary decks are pre-loaded into student iPads to streamline quantitative tasks.
- **Task Customization Pathways:** Teams maintain the explicit daily choice to run microscope observations and dissecting tasks independently or divide processing duties alongside a peer partner, managing their milestones with a student-led daily timeline.
- **Advanced students** can use their iPads to calculate ecological footprint metrics based on carbon sequestration values, modeling how the removal of key trophic levels alters the carbon sink capacity of pelagic ocean zones.



- Structured sentence frames are built directly into the lab documentation interfaces: If a marine ecosystem generates 50,000 kilograms of primary producer phytoplankton, only [blank] kilograms of biomass will be sustained at the primary consumer level because roughly 90 percent of the original energy is lost as [blank] during metabolic transfers.

Resources Provided:

- Digital marine ecology textbook materials (Garrison), interactive fisheries dashboards, and curated videos documenting pelagic community food webs.
- Core Energy Pack (Ecological calculation worksheets, 3D paper pyramid folding templates, gill raker structural guides, and sustainability rubrics).
- iPads, compound microscopes, plankton slides, fresh/preserved sardine specimens, dissection kits, scales, and sorting tokens.



Lesson Plan 3 Template

Content Area: Oceanography Lesson Title: Bioaccumulation of methylated Mercury 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: Environmental Science

Integration of Technology:

- Interactive ArcGIS StoryMaps to plot global mercury deposition hotspots, tracking atmospheric coal emissions down into marine trenches.
- Collaborative Google Sheets to compile classroom simulation data, instantly generating exponential curve graphs of toxin concentration.
- Cloud-based video annotation tools (e.g., Edpuzzle) to embed real-time biochemical analysis and policy checkpoints directly into documentary media streams.

Equipment Needed:

- Student laptops with internet access for mapping data and conducting research pathways.
- Compound light microscopes, glass slides, and coverslips.
- Fine-mesh plankton nets and concentrated local water samples containing living marine or freshwater micro-organisms.
- Preserved or fresh whole barnacles (filter feeders) and small whole baitfish or mackerel (pelagic consumers) for anatomical analysis.
- Dissection trays, fine scalpels, micro-forceps, and magnifying loupes.
- Biomagnification simulation kit: 30 small plastic cups (phytoplankton), 10 medium cups (zooplankton), 3 large cups (forage fish), 1 extra-large beaker (apex predator), and 500 colored micro-beads representing hydrophobic methylmercury molecules.

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Understand the mechanism of bioaccumulation and biomagnification, distinguishing how toxins build up within an individual over time	Lesson Sequence 1. Phenomenon: An environmental health advisory warns that while eating filter-feeding blue mussels harvested near a coastal harbor poses zero	• Mathematical Biomagnification Log & Trophic Data Sheet: A completed calculation matrix documenting the



versus how they amplify across ascending trophic levels. • Calculate levels of mercury accumulation at each trophic level using authentic parts-per-million (ppm) marine data sets and exponential amplification equations. • Make food selection choices to decrease exposure to toxins, applying public health data to design an optimized, low-mercury weekly nutritional regimen. • See the connection between the marine entertainment industry and the food system, critically evaluating how regional commercial seafood markets intersect with the exploitation of apex marine mammals.	neurological risk, consuming a single adult swordfish or striped bass from those exact same waters exceeds the safe weekly heavy metal limit for humans by over 800%. 2. 'Engage Phenomenon Activity 3. Begin with a current-event hook using headlines, short articles, or images showing mercury contamination advisories in seafood. 4. Public Health Misconception Hack: The lesson opens with students examining actual state-issued fish consumption advisory placards. Teams complete a "Notice/Wonder" chart on their laptops to address common misconceptions, explaining on a shared pad why common consumer habits like cooking, grilling, or freezing fail to remove heavy metals bound to fish muscle tissue. 5. Trophic Station Lab & Microbial Methylation Benchmark: Students cycle through four laptop-driven concept building stations. The teacher pathways detail how inorganic industrial mercury from coal combustion undergoes anaerobic microbial methylation in hypoxic benthic sediments, turning into fat-soluble methylmercury that passes directly through biological membranes. 6. Barnacle vs. Fish Comparative Anatomy	precise multi-generational accumulation of methylmercury parts-per-million (ppm) levels across a 4-tier system. • Filter-Feeder vs. Carnivore Structural Analysis Diagram: Microscope sketches and anatomical annotations explaining how filter-feeding structures limit a barnacle's trophic magnification compared to the high-exposure predatory lifestyle of pelagic fish. • Documentary Analytical Argument & Media Literacy Portfolio: A structured Claim-Evidence-Reasoning (CER) essay evaluating the economic ties between marine mammal captivity loops and the toxic distribution of apex meat in consumer markets. • Sustainable Low-Mercury Dietary Blueprint: A student-designed weekly menu matrix that maximizes omega-3 fatty acid
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	Micro-Lab: Pairs configure compound microscopes to inspect the filter-feeding thoracic appendages (cirri) of barnacles alongside the predatory jaw morphology of a consumer fish. Students observe plankton samples to contrast direct filter-feeding against active predation, recording a formal data-backed prediction detailing which feeding pathway triggers higher heavy metal exposure. 7. Hands-On Cross-Trophic Biomagnification Simulation: Students run a physical simulation modeling toxin transfer. Small plastic cups (producers) receive 2 "mercury beads" along with water; primary consumers "eat" three producers by pouring all contents into their medium cups; the process scales up to the apex predator beaker. Students count the final bead concentration, experiencing how non-biodegradable toxins exponentially concentrate at the top point of the food web despite the 10% loss of thermodynamic energy. 8. Media Literacy and Food System Analysis (<i>The Cove</i>): The class analyzes selected documentary segments from <i>The Cove</i>, tracking how apex marine mammal harvesting interacts with regional consumer seafood markets. Students trace the supply	intake while utilizing trophic calculations to keep total weekly methylmercury exposure below the EPA threshold of 0.1 micrograms per kilogram of body weight per day. • Students will define bioaccumulation as the gradual accumulation of a toxic substance in the tissue of a single living organism over its lifespan, contrasting it clearly against cross-trophic biomagnification on an exit card. • Students will calculate that if a primary producer contains 0.02 ppm of methylmercury and the toxin amplifies tenfold at each step, an apex predator at the fourth trophic level will reach a dangerous concentration of 2.0 ppm
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- chain pathways where mislabeled dolphin meat enters commercial food lines, completing structured Cornell notes that evaluate the intersection of marine entertainment parks, drive hunts, and public mercury poisoning.
9. Consumer Advocacy Design Workshop: Utilizing their calculated simulation data and official EPA/FDA fish safety indices, students select a vulnerable target demographic (e.g., pregnant women, developing children, or subsistence fishing communities). They build a digital consumer awareness pamphlet or media draft outlining safe seafood alternatives, establishing clear trophic rules for selecting low-exposure marine proteins.

Differentiation:

- Representation and Product Pathway Options: Students select their final mastery platform by drafting a traditional scientific policy proposal, recording an audio podcast dissecting environmental justice issues in coastal fisheries, formatting a visual infographic, or presenting a digital slideshow.
- Scaffolded Quantitative Frameworks: Students needing mathematical support receive pre-factored exponential equations, color-coded trophic tier guides, and split-screen calculation windows on their laptops to ease data entry.
- Adaptable Material Access: All readings, case studies (such as the historical Minamata Bay mercury disaster), and data sets are provided at multiple lexile levels and feature screen-reader accessibility options on all student interfaces.
- Advanced learners are provided with scientific journal excerpts detailing how accelerating climate change and warming ocean temperatures alter the metabolic rates of marine predators, calculating how increased consumption rates amplify heavy metal biomagnification factors.
- Sentence frames integrated into the data sheets support structured reasoning: Because methylmercury is a fat-soluble toxin that cannot be easily excreted, it undergoes [blank] within



an individual's tissues over time, which causes [blank] predators at the top of the food chain to suffer the highest neurological risks.

Resources Provided:

- Oceanography digital media assets (Garrison textbook), global GIS pollution mapping layers, and official FDA/EPA commercial fish consumer safety charts.
- Documentary viewing guides, ethical prompt rubrics, and policy role-play profiles for *The Cove* film analysis.
- Classroom lab packs (Dissection trays, preserved specimens, compound light microscopes, simulation beakers, and heavy metal modeling beads).



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

Curriculum Design Template

Content Area: Science	Grade Level: 11-12	Unit Title: Life in the Ocean and Communities
Created: 2026	Board Approved on:	Type Here



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
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



SPRINGFIELD PUBLIC SCHOOLS

**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
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:



SPRINGFIELD PUBLIC SCHOOLS

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

IEP AND 504 ACCOMMODATIONS 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



SPRINGFIELD PUBLIC SCHOOLS

**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



SPRINGFIELD PUBLIC SCHOOLS

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



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
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.