Course: Biology **Unit #1:** *Ecosystems*	**Year of Implementation:** 2026-2027

Curriculum Team Members *Kellie Balkus (kbalkus@lrhsd.org), Kelly Eichman (keichman@lrhsd.org), Rachel Senft (rsenft@lrhsd.org), Robert Spaeth (rspaeth@lrhsd.org), Lisa Stickel (lstickel@lrhsd.org)*

Stage One - Desired Results

Link(s) to New Jersey Student Learning Standards for this course:
https://www.state.nj.us/education/cccs/2020/

- **Unit Standards:**
  - ***Content Standards***
    - **HS-LS1-2**: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
    - **HS-LS1-3**: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
    - **HS-LS1-5**: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
    - **HS-LS1-6:** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon based molecules.
    - **HS-LS1-7:** Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.
    - **HS-LS2-1:** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
    - **HS-LS2-2:** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
    - **HS-LS2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

- **HS-LS2-4:** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- **HS-LS2-5:** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- **HS-LS2-6:** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- **HS-LS2-7:** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- **HS-LS2-8:** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- **HS-ESS2-6:** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- **HS-ESS3-3:** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- **HS-ESS3-6:** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).
- **HS-ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **HS-ETS1-4:** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

- ***21st Century Life & Career Standards***

  https://www.nj.gov/education/standards/clicks/Docs/2020NJSLS-CLKS.pdf

  - 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas
  - 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice
  - 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving
  - 9.4.12.DC.7: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society
  - 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday

objects allow for innovative technological approaches to climate protection.

- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others
- 9.4.12.IML.1: Compare search browsers and recognize features that allow for filtering of information. • 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
- 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately
- • 9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

- ***English Companion Standards***

  https://www.nj.gov/education/standards/ela/Docs/2016NJSLS-

  - NJSLSA.R1. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
  - NJSLSA.R2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
  - NJSLSA.R3. Analyze how and why individuals, events, and ideas develop and interact over the course of a text
  - NJSLSA.R7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
  - NJSLSA.R8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence
  - NJSLSA.R9. Analyze and reflect on how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

- NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.

- ***Interdisciplinary Content Standards***
  - N-Q.1–3: Quantities and units in context (e.g., biomass, energy flow, population).
  - A-CED.1–4: Creating equations to model real-world phenomena (e.g., predator-prey relationships).
  - S-ID.1–6: Summarizing, representing, and interpreting data (e.g., biodiversity studies).
    RST.11-12.1: Cite scientific text to support claims (e.g., environmental impact studies).
  - RST.11-12.7: Integrate visuals/data with text (e.g., ecosystem models, infographics).
  - WHST.11-12.2: Write scientific explanations and arguments.
  - 6.3.12.GeoGI.1: Analyze the impact of human activities on the environment.
  - 6.1.12.EconGE.6.a: Evaluate how economic development and industrialization impact ecosystems
  - 6.3.12.CivicsPI.1: Propose and advocate for solutions to environmental problems.
  - WHST.11-12.7: Conduct short research projects (e.g., case studies of ecological change).

- ***NJ Statutes:*** NJ State law mandates the inclusion of the following topics in lesson design and instruction as aligned to elementary and secondary curriculum.

  Amistad Law: N.J.S.A. 18A 52:16A-88 Every board of education shall incorporate the information regarding the contributions of African-Americans to our country in an appropriate place in the curriculum of elementary and secondary school students.

  Holocaust Law: N.J.S.A. 18A:35-28 Every board of education shall include instruction on the Holocaust and genocides in an appropriate place in the curriculum of all elementary and secondary school pupils. The instruction shall further emphasize the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens.

  LGBT and Disabilities Law: N.J.S.A. 18A:35-4.35 A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's

implementation of the New Jersey Student Learning Standards (N.J.S.A.18A:35-4.36) A board of education shall have policies and procedures in place pertaining to the selection of instructional materials to implement the requirements of N.J.S.A. 18A:35-4.35.

Diversity and Inclusion (N.J.S.A. 18A:35-4.36a) A board of education shall incorporate instruction on diversity and inclusion in an appropriate place in the curriculum of students in grades kindergarten through 12 as part of the district's implementation of the New Jersey Student Learning Standards.

Asian American and Pacific Islanders (AAPI) P.L.2021, c.410 Ensures that the contributions, history, and heritage of Asian Americans and Pacific Islanders (AAPI) are included in the New Jersey Student Learning Standards (NJSLS) for Social Studies in kindergarten through Grade 12 (P.L.2021, c.416)

For additional information, see

NJ Amistad Curriculum: ***https://www.nj.gov/education/amistad/about/***

Diversity and Inclusion: ***https://www.nj.gov/education/standards/dei/index.shtml***

- *(Sample Activities/ Lessons):* ***https://www.nj.gov/education/standards/dei/samples/index.shtml***

Asian American and Pacific Islanders:

- ***Asian American and Pacific Islander Heritage and History in the U.S.***
  A Teacher's Guide from EDSITEment offering a collection of lessons and resources for K-12 social studies, literature and arts classrooms that center around the experiences, achievements and perspectives of Asian Americans and Pacific Islanders across U.S. history.

Transfer Goal: *Students will independently analyze how small biotic or abiotic changes can significantly impact ecosystems and apply this understanding to real-world environmental issues, personal choices, and human effects on ecological balance.*

As aligned with LRHSD Long Term Learning Goal(s): https://www.lrhsd.org/academics/curriculum

1. design, critique, and carry out experiments in order to investigate scientific questions and/or propose solutions
2. collect, interpret, and analyze data in order to solve a defined problem
3. apply mathematics to express relationships efficiently and accurately

4. draw evidence-based conclusions from data in order to make informed decisions;
5. construct, interpret, and refine models (scientific and mathematical) to explain the physical and natural world
6. effectively communicate scientific ideas and evidence-based arguments to an appropriate audience through written and oral means
7. evaluate the validity of arguments that rely on scientific reasoning presented in the popular press and informational sources

Enduring Understandings	*Essential Questions*
Students will understand that. . . *EU1* *both cells and populations rely on transport mechanisms and feedback systems to maintain stability and homeostasis.* *EU 2* *ecosystems are dynamic systems where the flow of energy and cycling of matter support life and maintain balance.* *EU 3* *human activities can disrupt ecosystem stability, impacting biodiversity and the health of the planet.*	● *How do small changes at the molecular, cellular, and organismal level impact the function and stability of an ecosystem?* ● *How can understanding ecosystem dynamics inform environmental decisions and human actions?*
Knowledge *Students will know . . .* *EU 1* ● at the cellular level, processes like diffusion, osmosis, and active transport regulate material flow to sustain homeostasis (LS1.A) (CCC5) ● feedback mechanisms are essential for maintaining homeostasis by detecting changes in an organism's internal and external environment and triggering responses that restore balance. (LS1.A) (CCC4)	*Skills* *Students will be able to. . .* *EU 1* ● plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. (SEP1)(CCC1)(CCC2) ● demonstrate cellular transport mechanisms of different substances within a cell. (SEP3)(CCC4) ● make predictions about the movement of substances based on differences in concentration. (SEP5)(CCC1)

● at the population, community, and ecosystem level, dynamic interactions help maintain balance. (LS.2.A)(CCC7) ● ecosystems have carrying capacities which limit the numbers of organisms and populations they can support (LS2.A) ● Carrying capacity limits result from such factors as the availability of living and nonliving resources and from such challenges as predation, competition, and disease. (LS2.A)(CCC2)	● make predictions using models about the impact of the addition or removal (either natural or anthropogenic) of a species has on an ecosystem. (SEP2)(CCC4) ● analyze the interrelationships and interdependencies among different organisms, and explain how these relationships contribute to the stability of the ecosystem. (SEP6) (CCC7) ● use evidence from population studies to explain why exponential growth is unsustainable in natural ecosystems. (SEP7) (CCC7)
EU 2 ● at each link in an ecosystem, matter and energy are conserved; some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded (LS1.C)(CCC5) ● producers like plants or algae form the lowest level of the food web and utilize the sun's energy to create the foundation of every ecosystem.(LS.2.B) ● at each link upward in a food web/pyramid, 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. (LS.2.B)(CCC5) ● the process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide and water into sugars releasing oxygen. (PS3.D) ● photosynthesis and cellular respiration provide most of the energy for life processes (LS.2.B)	*EU 2* ● construct and revise an explanation based on evidence for the cycling of matter and flow of energy. (SEP6)(CCC5) ● interpret models, graphs, food web data, and/or respiration rate charts to identify patterns of energy flow and matter cycling. (SEP4) (CCC1) (CCC4) ● calculate energy transfer from one trophic level to the next (SEP3) ● write CER explanations to describe how photosynthesis supports all life in an ecosystem. (SEP7) ● design and conduct experiments (virtual or hands-on) that explore photosynthesis and respiration. (SEP3) ● justify how human activities (e.g., fossil fuel burning, deforestation) impact the carbon cycle. (SEP6) ● use models to demonstrate the formation or breakdown of larger biological molecules from simpler ones. (SEP5)(CCC4)

● cellular respiration releases energy through breaking the high-energy chemical bonds to obtain the energy needed for life processes (LS.2.B) ● photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, hydrosphere, and geosphere through chemical, physical, geological, and biological processes.(LS.2.B)(CCC5) ● hydrocarbon backbones are used to make amino acids and other carbon based molecules that can be assembled into larger molecules (such as proteins or DNA) (LS.1.C)	
EU 3 ● if a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient) (LS.2.C & LS.2.D)(CCC2) ● if a modest biological or physical disturbance to an ecosystem occurs, it can become a very different ecosystem (LS.2.C & LS.2.D)(CCC7) ● extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability possibly leading to extinction (LS.2.C & LS.2.D)(CCC7) ● anthropogenic changes (induced by human activity and human population growth) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can	*EU 3* ● interpret data from case studies to identify signs of ecosystem resilience and recovery after a disturbance. (SEP4)(CCC2) ● evaluate scenarios in which disturbance leads to ecosystem change, and construct an argument supported by evidence. (SEP 6) ● interpret biodiversity loss data to identify trends, causes, and potential consequences and preventative measures. (SEP 2)(CCC1) ● design or critique solutions to reduce human impact on ecosystems using real-world examples. (SEP6) ● propose conservation strategies and justify how they help preserve biodiversity or restore ecosystems. (SEP6) ● assess and create personal or community action plans to reduce ecological footprint and evaluate their potential impact. (SEP 7)

disrupt an ecosystem and threaten the survival of some species (LS.2.C & LS.2.D) ● biodiversity is increased by the formation of new species and the distribution of species, and decreased by the loss of species. (LS4.D, LS4.C) ● human activity is having adverse impacts on biodiversity. (LS4.D, LS4.C) ● recognize that conservation efforts (e.g., protecting endangered species, preserving habitats, biodiversity monitoring) aim to maintain or restore ecological balance. (ETS1.B) ● know that reducing an individual's ecological footprint (e.g., using less energy, reducing waste, consuming foods in a way that minimizes environmental impact, promotes human health, and supports ethical food production practices) can contribute to global environmental health.(ETS1.B) (CCC2)	

Stage Two - Assessment

Performance Task

Other Evidence:

- Laboratory activities
- Lab reports
- Quizzes and tests
- Concept maps, graphic organizers, charts, tables, and graphs
- Presentations
- Class discussion

Stage Three - Instruction

Learning Plan: **Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.** *{place A, M and/or T along with the applicable EU number in parentheses after each statement} All knowledge and skills must be addressed in this section with a corresponding lesson/activity which teaches each concept. The following color codes are used to notate activities that correspond with interdisciplinary connections and 21st Century Life & Career Connections (which involves Technology Literacy): Red = Interdisciplinary Connection; Purple = 21st Century Life & Career Connection*

Unit Phenomenon - Coral Bleaching and Reef Collapse: Entire coral reefs are turning white and dying after ocean temperatures rise by only a few degrees.

Unit Phenomenon Coral Bleaching and Reef Collapse Activities:

1. Coral Bleaching Video Analysis - NOAA Ocean Today - Coral Comeback Videos (EU1 A/M/T)
    a. Students will construct an initial model to explain the issue of coral bleaching.
    b. Students will think-pair-share models in small groups.
2. CER prompt: "Why do you think a small change in ocean temperature is causing this widespread bleaching?" (EU1 M)
3. LAB: Virtual/Real Microscope Lab examining algae cells and coral tissue structure (EU1 A)
4. Build or draw a coral polyp and its symbiotic algae (EU1 A)
    a. Revisit Coral Bleaching Phenomenon and initial model.
    b. Revise initial model or create a new model adding in new acquired knowledge.
    c. Teacher facilitated class discussion - "What did you add or modify from your initial model?"

5. Use a digital coral bleaching simulation (HHMI Biointeractive: “Coral Bleaching Interactive”) (EU1 A)
6. Create a model showing what happens inside a coral cell during bleaching (EU1 A)
7. Build a food web and simulate the collapse after coral loss (EU2,3 M)
    a. Revisit Coral Bleaching Phenomenon and model.
    b. Revise model adding in new acquired knowledge.
    c. Teacher facilitated class discussion - “What did you add or modify from your model?”
8. Predict population changes using role-playing or cards to simulate trophic cascades (EU2,3 M)
9. Interpret real reef biodiversity data before and after bleaching events. (EU3 M)
10. Graphing and CER based on the food web model (EU2 T)
11. Coral farming, marine protected areas, and reducing carbon emissions (case studies) (EU3 T)
    a. Revisit Coral Bleaching Phenomenon and model.
    b. Revise model adding in new acquired knowledge.
    c. Small Group Discussion - “What did you add or modify from your model and why?”
12. Debate/Socratic Seminar “Should governments prioritize coral reef conservation?” (EU3 T)
13. Project: Design an awareness campaign or mini science fair display on what humans can do to protect coral reefs (EU3 T)
14. HHMI Population Dynamics Simulation (EU3 A/M/T)
15. Return to Coral Bleaching Phenomenon and Revised Model (EU1,2,3 A/M/T)
    a. Small group discussions based on recent lessons:
        i. What aspects of the model are inaccurate or incorrect?
        ii. What aspects of the model still seem relevant?
        iii. What aspects now appear to be missing?
        iv. What new concepts could be used to give a more detailed explanation?
    b. Individual task: Revise to construct detailed final coral bleaching model.

Additional Unit 1 Ecosystem(s) Activities:

1. Energy Flow in Ecosystems, Biomass Calculations Energy Flow in Ecosystems: Biomass Worksheet (EU1,2,3 M/T)
2. Calorie Lab - Measuring Food Energy Calorie Lab: Measuring Food Energy Instructions (EU2 A/M)
3. “Like Dissolves Like” Activity Like Dissolves Like Demo (EU1 A/M/T)
4. Diffusion Prediction Practice Diffusion Practice Problems.pdf (EU1 M)
5. Celery and Potato Osmosis Demo Osmosis Demo with Celery and Potato (EU1 M)

6. Photosynthesis and the Scientific Method Photosynthesis and the Scientific Method (EU2 A/M)
7. Cell Respiration and Exercise Lab CR & Exercise Lab (EU2 A/M)
8. Scientific Method, Photosynthesis, Energy Flow, Data Collection and Analysis, AI Technology Gardyn Grow Hydroponic Tower(s) (EU2 A/M/T)

Pacing Guide

Unit #	***Title of Unit***	***Approximate # of teaching days***
1	Ecosystems	60 days
2	Genetics	45 days
3	Evolution	30 days

Instructional Materials

- *Prepared Slides (algae and coral)*
- *Microscopes*

Accommodations

Special Education: The curriculum will be modified as per the Individualized Education Plan (IEP). Students will be accommodated based on specific accommodations listed in the IEP.

Students with 504 Plans: Students will be accommodated based on specific accommodations listed in the 504 Plan.

English Language Learners: Students will be accommodated based on individual need and in consultation with the ELL teacher.

Students at Risk of School Failure: Students will be accommodated based on individual need and provided various structural supports through their school.

Gifted and Talented Students: Students will be challenged to enhance their knowledge and skills through acceleration and additional independent research on the subject matter.