EAST PENN SCHOOL DISTRICT

Global Science Inquiry
July 14, 2025

Global Science Inquiry Unit 1 - Coral Reefs

STAGE 1 | DESIRED RESULTS
Context and relevance for student learning

Standards

3.4.9-12.C Analyze and interpret how issues, trends, technologies, and policies impact watersheds and water resources

3.4.9-12.D Apply research and analytical skills to systematically investigate environmental issues ranging from local issues to those that are regional or global in scope.

3.4.9-12.E Plan and conduct an investigation utilizing environmental data about a local environmental issue.

3.1.9-12.K Students who demonstrate understanding can develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere,

Transfer

Students will be able to independently use their learning to...(make purpose-takeaway in 5 years)

- ❏ Examine, develop, analyze, and interpret how watersheds function as a system and are impacted by external factors.
- ❏ Engage in informed use of land and water to contribute to a positive impact on local watersheds and wetlands.
- ❏ Integrate scientific practices to research and investigate complex issues, problems, and phenomena.
- ❏ Understand, describe, and communicate the interconnected nature of local, regional, national, and global scales of environmental issues.
- ❏ Evaluate and engage in discussion surrounding local and global issues that relate to resource use and management.
- ❏ Examine, analyze, interpret, and apply how an individual and community impacts the use and management of natural resources.
- ❏ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.

Meaning

UNDERSTANDINGS
Students will understand that...

- ☐ Watersheds and wetlands function as interconnected systems that support, impact, and are influenced by living things.
- ☐ The environment provides multi-faceted opportunities to develop and apply interdisciplinary literacy skills to investigate complex issues at various scales.
- ☐ Conducting scientific investigations using place-based inquiry and authentic, outdoor field experience(s) is essential to understanding local environmental issues.
- ☐ The cycling of matter and the flow of energy within ecosystems occur through interactions among

ESSENTIAL QUESTIONS
Students will keep considering...

- ☐ How do watersheds and wetlands function as interconnected systems that support, impact, and are influenced by living things?
- ☐ How do human actions impact the functions of watersheds and wetlands?
- ☐ How do investigations of local environmental issues expand understanding and facilitate potential solutions to other local, regional, and/or global environmental issues?
- ☐ How can conducting local field investigations lead to identifying, understanding, and addressing environmental issues in my community?

atmosphere, hydrosphere, and geosphere. 3.2.9-12.E Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. 3.2.9-12.G Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Other supporting STEELS standards: 3.3.9-12.H Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems. 3.3.9-12.K Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. 3.3.9-12.L Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. 3.3.9-12.M Use a computational representation to illustrate the relationships among Earth	different organisms and between organisms and the physical environment. ☐ The atoms of some substances combine or rearrange to form new substances that have different properties. ☐ As the environment and populations of species change, there are resulting changes in ecosystems.	☐ How do matter and energy move through an ecosystem? ☐ How does one characterize and explain these reactions and make predictions about them? ☐ How do substances combine or change (react) to make new substances?
	Acquisition(need to align with above and standards)	
	Students will know... ☐ Anthropogenic changes (induced by human activity) in the environment— including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species (LS2.C with 3.4.9-12.C/E) ☐ Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). Humans depend on the living world for the resources and other benefits provided by biodiversity. Human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity aids humanity by preserving landscapes of recreational or inspirational value (LS4.D with 3.4.9-12.C/D/E). ☐ Resource availability has guided the development of human society (ESS3.1A with 3.4.9-12.C). ☐ A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in	*Students will be skilled at...* ☐ Develop and analyze a model that demonstrates the interactions between Earth's systems and the carbon cycle. ☐ Make predictions about how the greenhouse effect will change Earth's temperature and affect climate change in the future. ☐ Plan and carry out an investigation to determine the factors that affect the rates of a reaction and construct an explanation for those factors based on diffusion. ☐ Plan and carry out an investigation to determine the pH of a solution experimentally. ☐ Develop and use a model to show symbiotic relationships in an ecosystem ☐ Construct an explanation to support how increased atmospheric gasses affects ocean systems and how these changes, along with pH changes, affect organisms and the ecosystem as a whole ☐ Develop and use a model to illustrate the atoms/molecules present in an oceanic system Other skills ☐ Use the law of conservation of mass to write balanced chemical equations to show proportions and quantities of reactants and products. ☐ Compare and contrast patterns of the solubilities and concentrations of solutions. ☐ Make predictions about how concentrations will affect diffusion.

systems and how those relationships are being modified due to human activity. 3.3.9-12.S Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. 3.1.9-12.M 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.	terms of resources and habitat availability (LS2.C with 3.4.9-12.D). ☐ 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 (LS4.D with 3.4.9-12.D/E). ☐ 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 (LS2.B with 3.1.9-12.K) ☐ The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis (LS3.D with 3.1.9-12.K) . ☐ 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 (LS2.B) ☐ Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy (PS1.B with 3.2.9-12.E). ☐ The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions (PS1.B with 3.2.9-12.G).	☐ Use chemical equations to make predictions about the effects of acidic solutions on substances ☐ Analyze positive and negative feedback loops in earth systems ☐ Determine how organisms maintain homeostasis through different variables. ☐ Making connections between our local watersheds to coral reefs of community oceans using data. ☐ Analyze proxy data to predict future climate patterns and impacts.

Global Science Inquiry Unit 2 - Farmlands

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.1.9-12.E Students who demonstrate understanding can use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

3.4.9-12.A Students who demonstrate understanding can analyze and interpret how issues, trends, technologies, and policies impact agricultural, food, and environmental systems and resources.

3.4.9-12.F Students who demonstrate understanding can evaluate and communicate the effect of integrated pest management practices on indoor and outdoor environments.

3.4.9-12.G Students who demonstrate understanding can analyze and evaluate how best resource management practices and environmental laws achieve sustainability of natural resources.

Transfer

Students will be able to independently use their learning to...(make purpose-takeaway in 5 years)

- ☐ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
- ☐ Make informed decisions and identify solutions to environmental challenges.
- ☐ Engage in informed consumer practices and choices that take into account the impact on agricultural and environmental systems.
- ☐ Categorize, analyze, and interpret how humans and environmental systems relate and affect one another.
- ☐ Evaluate cost-benefit analysis in addressing solutions to environmental impacts.
- ☐ Understand how complex human and natural systems interact with each other and use empathy and data-informed evidence to make choices for the well-being of other species, including humans, and the environment.

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ The structures, functions, and behaviors of organisms allow them to obtain, use, transport, and remove the matter and energy needed to live.
- ☐ Living things, including humans, utilize natural resources in ways that impact agricultural and environmental systems.
- ☐ Conducting scientific investigations using place-based inquiry and authentic, outdoor field experience(s) are essential to understanding local environmental issues.
- ☐ Best management practices and data driven resource management, as well as environmental laws and policies, encourage environmental sustainability.
- ☐ When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How do organisms obtain and use the matter and energy they need to live and grow?
- ☐ How do living things utilize natural resources in ways that impact agricultural and environmental systems? How do agricultural systems interact with environmental systems?
- ☐ How do we balance societal values, practices, and cost-benefit analysis (long-term and short-term) in addressing environmental issues?
- ☐ How do actions and regulations support the equitable availability of resources for current and future generations?

3.3.9-12.M Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. Other supporting STEELS standards: 3.3.9-12.Q Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. 3.1.9-12.M 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.	social, cultural, and environmental impacts. ☐ The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.	
	Acquisition(need to align with above and standards)	
	Students will know...	**Students will be skilled at...**
	☐ The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen (LS1.C with 3.1.9-12.E). ☐ A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population can challenge the functioning of ecosystems in terms of resources and habitat availability (LS2.C with 3.4.9-12.A). ☐ Resource availability has guided the development of human society (ESS3.A with 3.4.9-12.A). ☐ The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources (ESS3.C with 3.4.9-12.A/G). ☐ 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 (ETS1.B with 3.4.9-12.G).	☐ Develop a model diagraming the process of photosynthesis ☐ Analyze and interpret real-world data sets (e.g., crop yields, soil quality indices, biodiversity counts, or water usage) to evaluate the impact of different farming practices on ecosystem stability and resource sustainability. ☐ Construct and defend evidence-based arguments to evaluate the effectiveness of innovative farming technologies or practices in reducing environmental impacts while maintaining agricultural productivity. ☐ Obtain and evaluate information from multiple credible sources to compare the environmental impacts of current agricultural practices, and communicate evidence-based proposals for more sustainable and innovative farming solutions. ☐ Develop and use a model to explain how plants reproduce, and the role of pollination in the process. Other skills ☐ Explain how the process of photosynthesis converts sunlight into energy. ☐ Label the structures of a plant and identify their functions. ☐ Explain the role of gametes in plant reproduction. ☐ Evaluating the pros and cons of various agricultural practices. ☐ Predict the impact of agricultural inputs and practices on the local and global ecosystems. ☐ Evaluate the practice of Integrated pest management. ☐ Predict how sustainability practices will impact the local and global ecosystems.

		☐ Explain how human population has increased in size and become more globalized ☐ Explain the economical impacts farmland and agriculture have on local and global communities. ☐ Evaluate management practices and how environmental laws have had an impact on farming and the environment.

Global Science Inquiry Unit 3 - Glaciers

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.4.9-12.C Analyze and interpret how issues, trends, technologies, and policies impact watersheds and water resources.

3.4.9-12.H Design and evaluate solutions in which individuals and societies can promote stewardship in environmental quality and community well-being.

3.4.9-12.I Analyze and interpret data on a regional environmental condition and its implications on environmental justice and social equity.

3.1.9-12.M Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but

Transfer

Students will be able to independently use their learning to...(make purpose-takeaway in 5 years)

- ☐ Engage in informed use of land and water to contribute to a positive impact on local watersheds and wetlands.
- ☐ Make informed decisions and identify solutions to environmental challenges.
- ☐ Evaluate cost-benefit analysis in addressing solutions to environmental impacts
- ☐ Recognize environmental injustices and take actions to mitigate them at various scales.
- ☐ Examine, develop, analyze, and interpret how watersheds function as a system and are impacted by external factors.

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ Watersheds and wetlands function as interconnected systems that support, impact, and are influenced by living things.
- ☐ Environmental stewardship practices are essential to improving environmental quality, sustainability, and community well-being.
- ☐ Environmental justice plays an important role in providing equitable protection from environmental hazards or concerns for all people.
- ☐ As the environment and populations of species change, there are resulting changes in ecosystems.
- ☐ When the environment changes, some individuals in a population may have traits that provide a reproductive advantage which over many generations can change the makeup of a population.
- ☐ When the environment changes, some individuals in a population may have traits that provide a reproductive advantage which over

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How do watersheds and wetlands function as interconnected systems that support, impact, and are influenced by living things?
- ☐ How do human actions impact the functions of watersheds and wetlands?
- ☐ How can human actions improve environmental quality, sustainability, and community well-being?
- ☐ How do human actions impact environmental justice issues for individuals and communities?
- ☐ How do human actions impact the equitable access, use, and disposal of natural resources?
- ☐ How do environmental changes impact ecosystems?
- ☐ How does the environment influence populations of organisms over multiple generations?
- ☐ How does the environment influence populations of organisms over multiple generations?

changing conditions may result in a new ecosystem. 3.1.9-12.V Students who demonstrate understanding can 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. 3.1.9-12.X Students who demonstrate understanding can 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. Other supporting STEELS standards: 3.3.9-12.E Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.	many generations can change the makeup of a population.	
	Acquisition(need to align with above and standards)	
	Students will know... ☐ Anthropogenic changes (induced by human activity) in the environment— including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species (LS2.C with 3.4.9-12.C/I). ☐ Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value (LS4.D with 3.4.9-12.C/3.1.9-12.V). ☐ The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources (ESS3.C with 3.4.9-12.H). ☐ 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 (ETS1.B with 3.4.9-12.H). ☐ The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources (ESS3.C with 3.4.9-12.I). ☐ A complex set of interactions within an ecosystem can keep its numbers and types of organisms	**Students will be skilled at...** ☐ Analyze and interpret long-term data on glacial retreat, temperature change, and species distribution to evaluate how melting glaciers affect ecosystem stability and biodiversity. ☐ Construct evidence-based explanations for how human activities contribute to glacial retreat and design potential engineering or policy solutions that mitigate these impacts on Earth's systems. ☐ Use mathematical and computational thinking to test a solution to mitigate the adverse impacts of human activity on glacial melting. ☐ Develop and use a model demonstrating how melting glaciers result in new ecosystems developing. ☐ Analyze and interpret proxy data to predict future climate patterns and impacts ☐ Plan and carry out an investigation to understand how changing albedo contributes to climate change. Other skills ☐ Explaining effects of glacial advance and retreat on local watersheds. ☐ Design and evaluate solutions to mitigate the risks of rising sea levels. ☐ Construct an explanation on how glacial retreat impacts coastal cities in comparison to inland communities. ☐ Analyze positive and negative feedback loops in earth systems. ☐ Evaluate how carbon dioxide levels are directly connected to climate change and the energy budget. ☐ Analyze patterns of historic climate compared to current trends.

3.3.9-12.H Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems. 3.3.9-12.S Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.	relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability (LS2.C with 3.1.9-12.M). ☐ 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 (LS4.C with 3.1.9-12.V/X). ☐ 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 (LS4.C with 3.1.9-12.X).	☐ Analyze patterns of geological evidence of previous presence of glaciers. ☐ Investigate heat transfer in earth systems

Unit 4 - Forests

STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards

3.4.9-12.B Apply research and analytical skills to evaluate the conditions and motivations that lead to conflict, cooperation, and change among individuals, groups, and nation.

3.4.9-12.G Analyze and evaluate how best resource management practices and environmental laws achieve sustainability of natural resources.

3.1.9-12.H Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

3.1.9-12.I Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

Transfer

Students will be able to independently use their learning to...(make purpose-takeaway in 5 years)

- ☐ Evaluate and engage in discussion surrounding local and global issues that relate to resource use and management.
- ☐ Examine, analyze, interpret, and apply how an individual and community impacts the use and management of natural resources.
- ☐ Understand how complex human and natural systems interact with each other and use empathy and data-informed evidence to make choices for the well-being of other species, including humans, and the environment.
- ☐ Evaluate systems, in order to connect how form determines function and how any change to one component affects the entire system.
- ☐ Make and use observations to analyze relationships and patterns in order to explain phenomena, develop models, and make predictions.

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ Human cultures and societies experience and interact with the environment in various ways.
- ☐ Best management practices and data driven resource management, as well as environmental laws and policies, encourage environmental sustainability.
- ☐ The total change of energy in any system is always equal to the total energy transferred into or out of the system.
- ☐ Ecosystems are complex systems that include both living (biotic) and non-living (abiotic) components that interact with each other.
- ☐ Ecosystems are complex systems that include both living (biotic) and non-living (abiotic) components that interact with each other.
- ☐ As the environment and populations of species change, there are resulting changes in ecosystems

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How do human cultures and societies experience, interact, and value local, regional, and/or global environments?
- ☐ How do various human cultures express their beliefs about nature and the environment?
- ☐ How are natural resources managed by people from various cultures and communities?
- ☐ How do actions and regulations support the equitable availability of resources for current and future generations?
- ☐ What is meant by conservation of energy?
- ☐ How is energy transferred between objects or systems?
- ☐ How do organisms interact with the living and nonliving environments to obtain matter and energy?

3.1.9-12.N Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. Other supporting STEELS standards: 3.1.9-12.V Create or revise a simulation to test a solution to mitigate the adverse impacts of human activity on biodiversity. 3.1.9-12.X 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.		☐ How do organisms interact with the living and nonliving environments to obtain matter and energy? ☐ How do environmental changes impact ecosystems?
	Acquisition(need to align with above and standards)	
	Students will know... ☐ A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population can challenge the functioning of ecosystems in terms of resources and habitat availability (LS2.C with 3.4.9-12.B). ☐ Resource availability has guided the development of human society (ESS3.A with 3.4.9-12.B). ☐ The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources (ESS3.C with 3.4.9-12.B). ☐ 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 (ETS1.B with 3.4.9-12.G). ☐ Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. ☐ Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. ☐ 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	**Students will be skilled at...** ☐ Obtain and evaluate information from multiple credible sources to explain how forest ecosystems respond to human activity and natural resource use, and communicate evidence-based strategies for promoting sustainable forest management. ☐ Construct and defend arguments based on evidence to evaluate the effectiveness of forest management strategies in reducing human impact on ecosystems, and advocate for innovative or improved solutions to support forest sustainability. ☐ Apply mathematical and computational thinking to model how energy and matter flow through forest ecosystems, and use calculations and simulations to evaluate the impact of sustainable and unsustainable forestry practices on these cycles. ☐ Use mathematical and computational tools to analyze population data and species interactions in forest ecosystems, and evaluate how changes in biodiversity and resource availability affect the stability and sustainability of those systems ☐ Develop and use models to show how matter moves and transfers through trophic levels ☐ Construct an explanation of types of ecological interactions that exist in forests ☐ Construct and defend arguments based on evidence to evaluate practices such as logging, clear-cutting, farming, etc. and

	upward, to produce growth and release energy in cellular respiration at the higher level. 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 (LS2.B with 3.1.9-12.H) ☐ Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem (LS2.A with 3.1.9-12.I). ☐ Anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species (LS2.C with 3.1.9-12.N) ☐ Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). • Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value (LS4.D with 3.1.9-12.N).	how they impact the environment, benefit/harm different groups of people, and design solutions to achieve sustainability. Other skills ☐ Identify biotic and abiotic factors and analyze the interactions between them. ☐ Design and analyze food web/chain diagrams ☐ Explain how anthropogenic activities create instability and causes change in the environment ☐ Analyze the effects of deforestation on ecosystems and biodiversity ☐ Make predictions about population changes using food chains/webs ☐ Explain threats to biodiversity ☐ Explain how chemicals accumulate in food chains/webs within an ecosystem, and design a solution. ☐ Explain how changes in limiting factors determine the carrying capacity of an environment.