ED I: Dynamic Cycles of Water Pollution, Monitoring and Treatment

This unit immerses students in a comparative case study: the ongoing fight waged by local citizens of Jalisco to save and clean their cherished Rio Santiago in Mexico; and the ongoing healing in Flint, MI, USA after a water crisis that shook the nation. Both scenarios are "perfect storms" of government corruption, systemic racism, health tragedies, inequitable power distributions, and of course environmental disaster. Students continue to access primary and secondary sources dating from 2003-2021, all chronicling the status of Rio Santiago, the Flint water supply, and the humans at the center of the narratives. The point source pollution studied in the fictitious town of Riverville in the last unit now springs to life, and students delve deeper into groundwater pollution, heavy metal contaminants, and corrosion in lead and iron pipes. They learn about concentration levels testing water samples of a fictitious Marion Town, and later summarize the designs of real-world freshwater monitoring studies. They use multiple models of biogeochemical cycles to visualize how chemicals cycle through the spheres. Students receive their Periodic Tables and use them to explore river water components—both welcome and unwelcome. They use their SEP to support their understanding of fundamental questions about pollution and its treatment. How do heavy metals end up in rivers, and what consequences do they have for human and wildlife health? How does water treatment help 'clean' the water? How are magnets used to engineer more efficient wastewater treatment processes, and how does it build on flocculation?

Students continue to leverage their science and engineering practices (SEP) with the analysis and interpretation of both qualitative and quantitative data, use molecular model kits for the first time, and are introduced to more sophisticated laboratory equipment. Students practice with sig figs as they learn how different measurement devices work, learn to calculate percent composition, and learn to use Chemix software, a laboratory materials & experimentation visualization tool. In the previous unit, students learned how pollution is a mixture and designed a simple water filtration apparatus. In this unit, they use more sophisticated laboratory equipment and methods to learn about filtration. They take time to learn the structure and function, as well as safe handling, of each of their lab materials, as they will be using them regularly! Throughout the unit, students leverage several scientific reports, as well as interactive diagrams, maps and models. This entire unit gives students the opportunity to work on a wide variety of science and engineering practices (SEP), particularly analyzing and interpreting data; constructing explanations; engaging in argumentation; evaluating and proposing solutions; and obtaining, evaluating, and communicating information. This unit combines Disciplinary Core Ideas (DCIs) from physical, life, earth and space sciences, and engineering. The core ideas continue to build on pollutant cycling through terrestrial and aquatic systems, but now focus on pure substances and types of mixtures; sources of pollution and ecological carbon cycles; chemical elements & compounds; and the negative impact that humans have on biodiversity, particularly via multi-systemic pollution over long periods of time and the process of bioaccumulation. Students learn about these phenomena in relation to all 7 Crosscutting Concepts – patterns; cause and effect; scale, proportion, and quantity; structure & function; systems & systemic models; energy & matter; stability and change (indicated by color below).

A note about the **UN Sustainable Development Goals (SDGs):** This unit continues to highlight SDG #6, *Clean Water and Sanitation*, and also: SDG #1: *No Poverty*; SDG #3, *Good Health and Well-being*; SDG #11: *Sustainable Cities and Communities*; SDG #12, *Responsible Production and Consumption*; and SDG #15, *Life on Land*. Display the SDGs icons in your classroom to familiarize students. Students will delve into the SDGs more closely at the end of the Strand when they receive their digital icons for the SDGs, along with a formal introduction.

Matrix of Environmental Principles and Concepts in CA NGSS (Grades 9-12)

Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.

- Human lives, communities, societies, and activities (e.g., agriculture, fisheries, and industry) depend on and benefit from the biodiversity of Earth's natural systems.
- The biodiversity of natural systems influences the quality, quantity, and reliability of the ecosystem goods and ecosystem services that human lives, communities, societies, and activities depend on.
- The availability and reliability of the ecosystem goods and ecosystem services that natural systems provide humans are directly affected by the size and growth of human populations, and their consumption rates, as well as the operation of human communities.

Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.

- Human social systems (e.g., laws, economics, and politics) and practices (e.g., methods used to extract, transport, and resource consumption) can alter natural systems processes and cycles, thereby influencing the carrying capacities of ecosystems and their geographic extent, composition, biological diversity, health, viability, and functioning.
- Human population growth and associated anthropogenic changes (e.g., habitat destruction, pollution, climate change, invasive species) result from extracting, harvesting, transporting, and consuming natural resources, and can lead to the disruption of natural systems, thereby influencing the functioning and geographic extent, composition, biological diversity, and viability of ecosystems and threatening the survival of some species.

Principle III: Natural systems proceed through cycles that humans depend upon, benefit from and can alter.

- Human practices, including the methods used to extract, harvest, transport and consume natural resources alter the cycles and processes that operate within natural systems, directly and indirectly influencing the quality, quantity, and reliability of ecosystem goods and ecosystem services available to support human lives, communities, and societies.
- Human activities can alter Earth's major cycles and processes influencing the geographic extent, composition, biological diversity, health, viability, and functioning of natural systems.
- Human-caused changes to cycles and processes in natural systems can diminish supplies of fresh water and clean air and may also result in global-scale changes such as: desertification, climate change, and decreased availability of arable soil.

Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

- The increasing consumption of resources (matter and energy) from growing human populations and associated activities is resulting in global-scale changes to natural systems (e.g., increased amounts of atmospheric carbon dioxide, overfishing, loss of tropical rainforests) which influence the capacity of Earth's natural systems to adjust to human-caused alterations.
- The byproducts of human activities (e.g., pollution, waste products) that result from the expansion and operation of human communities and the use of natural resources, influence the functioning and geographic extent, composition, biological diversity, and viability of ecosystems and can threaten the survival of some species.
- The scope, scale, and duration of human activities that consume natural resources and produce byproducts, influence the capacity of natural systems to recover from human-caused alterations and directly influence both the long-term viability of associated natural systems and the sustainability of human societies.

Principle V: Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes.

- The spectrum of what is considered in making decisions about natural systems and resources, and how those factors influence decisions, should take into account sustaining biodiversity and natural system function, as well as human dependence on the living world for the resources and other benefits provided by biodiversity.
- Decisions about the priority of certain criteria over others (trade-offs) should assess social, economic, and political factors, with particular emphasis on environmental factors that can influence the long-term functioning of affected ecosystems and the survival of the organisms that depend on them.

This unit also addresses the following understandings about the ***Nature of Science*** as described in Appendix H of NGSS:

- Scientific Investigations Use a Variety of Methods (MS&HS)
- Scientific Knowledge is Based on Empirical Evidence (MS&HS)
- Scientific Knowledge is Open to Revision in Light of New Evidence (MS&HS)
- Science, Models, Laws, Mechanisms, and Theories Explain Natural Phenomena (HS)
- Science is a Way of Knowing (MS&HS)
- Scientific Knowledge Assumes an Order and Consistency in Natural Systems (MS&HS)
- Science is a Human Endeavor (MS&HS)
- Science Addresses Questions About the Natural and Material World (MS&HS)

Performance Expectations (PE)
EduChange is guided by the CAST Item Specifications documents prepared for the CA Department of Education by ETS. Our multi-year program implements a grade-band approach, addressing PEs multiple times in different contexts. Thus, all PEs listed are addressed partially in a given unit. Related phenomena given in the CAST docs also are cited below for teacher guidance. Integrated Science I alignments include both MS and HS PEs.

HS PE: HS-LS2-5, HS-LS2-7, HS-ESS3-1, HS-ESS3-4, HS-ETS1-1, HS-ETS1-2
MS PE: MS-PS1-1, MS-PS2-5, MS-LS1-6, MS-LS2-1, MS-LS2-3, MS-LS2-4, MS-LS2-5, MS-ESS2-4, MS-ESS3-1, MS-ESS3-3, MS-ESS3-4
Related Phenomena/Contexts HS: The effects on the biosphere, atmosphere, hydrosphere, and geosphere of human activity (such as logging, industrialization, etc.) (HS-LS2-5); Negative impacts of human activities (HS-LS2-7); Unintended impacts of strategies designed to solve environmental problems (HS-ESS3-1); Wastewater treatment processes; Relevant physical principles; (HS-ESS3-4) Cost of development; Features of the local geography (HS-ETS1-1); Breaking down a problem into its temporal sequence/network of causes and effects; the MivaMag solution for wastewater treatment (HS-ETS1-2) **MS**: The placement and number of atoms within a molecule (MS-PS1-1); Iron filings in the vicinity of a bar magnet (MS-PS2-5); An environmental change that alters resource availability (MS-LS2-1); Geochemical cycles between biotic and abiotic factors in an ecosystem (MS-LS2-3); Effect of changes to soil or water chemistry (fertilizer use, pollution, etc.) on populations; Human-caused changes to the populations (e.g., overfishing, release of domestic animals, use of pesticides) (MS-LS2-4); Nutrient recycling (MS-LS2-5); The movement of water from the atmosphere to plants and from plants to the atmosphere; The movement of water over landmasses (MS-ESS2-4); Pollution, Water usage, Agriculture (MS-ESS3-3)
Explorations, Pre-Lab Activities, Lab, Assessments: *Who Contaminated Marion Town's Groundwater?; Mixture Type Predictions; A Story of Two Rivers: El Rio Santiago & the Flint River; Dr. Mona's Spatial Analysis; Cycles and Spheres; Intro to Magnetic Fields;* Laboratory Wastewater Treatment System, Materials Diagram, Procedure Purpose & Overview; *Magnets to the Rescue!*; Quiz, Strand Map questions

Related Science Framework Disciplinary Core Ideas (DCI) and Crosscutting Concepts (CCC)

Crosscutting Concepts Color Key	
■ = Patterns	■ = Energy and matter
■ = Cause and effect	■ = Structure and function
■ = Scale, proportion, and quantity	■ = Stability and change
■ = Systems and systemic models	Brackets [ ] denote additional cross-cutting concepts

Physical Sciences	**Life Sciences**	**Earth and Space Sciences**	**Engineering, Technology, and the Application of Science**
Matter and Its Interactions: Structure and Properties of Matter (PS1.A) Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) [This unit also connects this DCI to Energy and Matter.] [This unit also connects this DCI to Patterns.] Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-1) [This	**From Molecules to Organisms: Structures and Processes: Organization of Matter and Energy Flow in Organisms (LS1.C)** Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS) As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS) [This unit also connects this DCI to Systems and	**Earth's Systems: Earth's Materials and Systems (ESS2.A)** All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS) [This unit also connects this DCI to Systems and Systemic Models.] [This unit also connects this DCI to Stability and Change.] The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS) [This unit	**Engineering Design: Defining and Delimiting Engineering Problems (ETS1.A)** Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1) **Engineering Design: Developing Possible Solutions (ETS1.B)** A solution needs to be tested, and then modified on the basis of the test

Physical Sciences	Life Sciences	Earth and Space Sciences	Engineering, Technology, and the Application of Science
unit also connects this DCI to Energy and Matter.] Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS) [This unit also connects this DCI to Energy and Matter.] Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS) [This unit also connects this DCI to Energy and Matter.] The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS) [This unit also connects this DCI to Energy and Matter.] [This unit also connects this DCI to Patterns.] The structure and interactions of matter at the bulk scale are determined by electrical forces within and between	Systemic Models.] [This unit also connects this DCI to Stability and Change.] **Ecosystems: Interactions, Energy, and Dynamics: Interdependent Relationships in Ecosystems (LS2.A)** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS) [This unit also connects this DCI to Energy and Matter.] Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) [This unit also connects this DCI to Stability and Change.] **Ecosystems: Interactions, Energy, and Dynamics: Cycles of Matter and Energy Transfer in Ecosystems (LS2.B)** Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or	also connects this DCI to Systems and Systemic Models.] Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS) **Earth's Systems: The Role of Water in Earth's Surface Processes (ESS2.C)** Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) [This unit also connects this DCI to Systems and Systemic Models.] Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the	results, in order to improve it. (MS) Models of all kinds are important for testing solutions (MS) When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS) **Engineering Design: Optimizing the Design Solution (ETS1.C)** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2) [This unit also connects this DCI to Cause and Effect.]

Physical Sciences	Life Sciences	Earth and Space Sciences	Engineering, Technology, and the Application of Science
atoms. (HS) [This unit also connects this DCI to Energy and Matter.] **Matter and Its Interactions: Chemical Reactions (PS1.B)** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS) [This unit also connects this DCI to Energy and Matter.] [This unit also connects this DCI to Systems and Systemic Models.] In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS) [This unit also connects this DCI to Energy and Matter.] **Motion and Stability: Forces and Interactions (PS2.B)**	animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3) Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-5) **Ecosystems: Interactions, Energy, and Dynamics: Ecosystem Dynamics, Functioning, and Resilience (LS2.C)** Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) [This unit also connects this DCI to Cause and Effect.] Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS) Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of	viscosities and melting points of rocks. (HS) **Earth's Systems: Biogeology (ESS2.E)** 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-ESS3-6) [This unit also connects this DCI to Systems and Systemic Models.] **Earth and Human Activity: Natural Resources (ESS3.A)** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1) [This unit also connects this DCI to Energy and Matter.] [This unit also connects this DCI to Systems and Systemic Models.] Resource availability has guided the development of human society. (HS) [This unit also connects this DCI to Systems and Systemic Models.]	

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Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) [This unit also connects this DCI to Energy and Matter.] [This unit also connects this DCI to Systems and Systemic Models.] Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5) [This unit also connects this DCI to Systems and Systemic Models.] Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing	invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7) [This unit also connects this DCI to Cause and Effect.] [This unit also connects this DCI to Patterns.] **Biological Evolution: Unity and Diversity: Biodiversity and Humans (LS4.D)** Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (MS-LS2-5) [This unit also connects this DCI to Cause and Effect.] 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	All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS) [This unit also connects this DCI to Scale, Proportion and Quantity.] **Earth and Human Activity: Human Impacts on Earth Systems (ESS3.C)** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) [This unit also connects this DCI to Stability and Change.] Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3) (MS-ESS3-4) The sustainability of human societies and the biodiversity that supports them requires responsible	

Physical Sciences	**Life Sciences**	**Earth and Space Sciences**	**Engineering, Technology, and the Application of Science**
magnetic fields cause electric fields. (HS) [This unit also connects this DCI to Energy and Matter.] [This unit also connects this DCI to Systems and Systemic Models.] Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS) [This unit also connects this DCI to Energy and Matter.] [This unit also connects this DCI to Systems and Systemic Models.]	recreational or inspirational value. (HS-LS2-7)	management of natural resources. (HS) [This unit also connects this DCI to Cause and Effect.] [This unit also connects this DCI to Scale, Proportion and Quantity.] Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4) [This unit also connects this DCI to Scale, Proportion and Quantity.]	

Related NRC Framework Science and Engineering Practices

Asking questions and defining problems	**Developing and using models**	**Planning and carrying out investigations**	**Analyzing and interpreting data**
Ask questions • that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. (MS) • to identify and/or clarify evidence and/or the premise(s) of an argument. (MS) • to determine relationships between independent and dependent variables and relationships in models. (MS) • to clarify and/or refine a model, an explanation, or an engineering problem. (MS) • that require sufficient and appropriate empirical evidence to answer. (MS) • that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, appropriate, frame a hypothesis based on observations and scientific principles. (MS) • that challenge the premise(s) of an argument or the interpretation of a data set. (MS) • that arise from careful observation of	Develop and/or use a model to predict and/or describe phenomena. (MS) Develop a model to describe unobservable mechanisms. (MS) Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. (MS) Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. (HS) Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. (HS) Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types	Evaluate the accuracy of various methods for collecting data. (MS) Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or design to ensure variables are controlled. (HS) Select appropriate tools to collect, record, analyze, and evaluate data. (HS)	Distinguish between causal and correlational relationships in data. (MS) *Students do this without the vocabulary terms in the Flint MI data dive. Vocab introduced in Yr 2.* Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). (MS) Analyze and interpret data to provide evidence for phenomena. (MS) Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. (HS) Compare and contrast various types of data sets (e.g., self-generated, archival) to

Asking questions and defining problems	Developing and using models	Planning and carrying out investigations	Analyzing and interpreting data
phenomena, or unexpected results, to clarify and/or seek additional information. (HS) • that arise from examining models or a theory, to clarify and/or seek additional information and relationships. (HS) • to clarify and refine a model, an explanation, or an engineering problem. (HS) • that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. (HS) Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations. (HS)	based on merits and limitations. (HS)		examine consistency of measurements and observations. (HS) Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. (HS)

Related NRC Framework Science and Engineering Practices (continued)

Using mathematics and computational thinking	**Constructing explanations and designing solutions**	**Engaging in argument from evidence**	**Obtaining, evaluating, and communicating information**
Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. (MS) Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.).	Construct an explanation using models or representations. (MS) Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. (MS) Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. (MS) Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. (MS)	Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS) Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations). (HS)	Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). (MS) Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS) Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS) Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. (MS) Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS) Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a

Using mathematics and computational thinking	Constructing explanations and designing solutions	Engaging in argument from evidence	Obtaining, evaluating, and communicating information
			problem. (HS) Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible. (HS) Communicate scientific and/or technical information or 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 (i.e., orally, graphically, textually, mathematically). (HS)