Environmental Science:
Resources, Sustainability and Anthropogenic Impacts

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies:

- ***Cause & Effect Students will demonstrate the ability to investigate, explain, and evaluate potential causal relationships by using evidence to support claims and predictions about the mechanisms that drive those relationships.***
- ***Stability & Change in Systems Students will demonstrate the ability to investigate and analyze static and dynamic conditions of natural and human designed systems in order to explain and predict changes over time.***
- ***Nature of Science Student will demonstrate the ability to work collaboratively and individually to generate testable questions or define problems, plan and conduct investigations using a variety of research methods in a various settings, analyze and interpret data, reason with evidence to construct explanations in light of existing theory and previous research, and effectively communicate the research processes and conclusions.***
- ***Students will demonstrate the ability to analyze and summarize text and integrate knowledge to make meaning of discipline-specific materials.***
- ***Students will demonstrate the ability to produce coherent and supported writing in order to communicate effectively for a range of discipline-specific tasks, purposes, and audiences.***
- ***Students will demonstrate the ability to speak purposefully and effectively by strategically making decisions about content, language use, and discourse style.***

Content Standards:

- HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Transfer

*Students will be able to independently use their learning to **make educated decisions about the use of natural resources.***

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- 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.
- science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.
- many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.
- energy cannot be created or destroyed-it only moves between one place and another place, between objects and/ or fields, or between systems.

ESSENTIAL QUESTIONS

- *Are humans a natural part of ecosystems?*
- *Do current human needs supersede the natural cycling of ecological resources?*
- *How will the changing climate affect future populations?*

Acquisition

Students will know…

- that the availability of energy limits what can occur in any system.

Students will be skilled at…

- creating computational models.
- designing, building, and refining a device

● HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. ● HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). ● HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. ● 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-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost benefit ratios. ● 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 systems.	● that criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. ● that Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. ● that 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. ● that 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. ● that 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 re-radiation into space. ● that changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.	that works within given constraints. ● planning and conducting investigations. ● analyzing data. ● developing and using models based on evidence. ● evaluating competing design solutions.

	● that a complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. ● that 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. ● that, 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. ● that changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. ● that, 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. ● that 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 gasses added to the atmosphere each year and by the ways in which these gasses are absorbed by the ocean and biosphere. ● that resource availability has guided the development of human society. ● that 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. ● that 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. ● that the sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ● that scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. ● that, 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. ● that 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. ● that some 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. *vocabulary*: biodiversity, HIPPO (Habitat destruction and degradation, Invasive Species, Population Growth, Pollution, Overexploitation), hydrologic cycle, aquifer, lentic, lotic, watershed, terrestrial, oligotrophic, eutrophic, eutrophication, impervious surfaces, water footprint, hominid, Laetoli Footprints, homosapiens, Neanderthal, Out of Africa Theory, Mitochondrial Eve/ Adam Origin, biped/quadruped, fluctuation, total fertility, replacement level fertility, age structure diagrams, salinization, contamination, genetically modified organism (GMO), slash and burn agriculture, soil compaction, monoculture, perpetual resource, sustainability	
Content Area Literacy Standards		***21st Century Skills***
• RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. • RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. • RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. • RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. • RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. • RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. • RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.		• *make judgments and decisions* • *solve problems* • *think creatively* • *work creatively with others* • *implement innovations*

• WHST.11-12.1 Write arguments focused on *discipline-specific content*. • WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. • WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. • WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. • WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	

Stage 2 - Evidence

Evaluative Criteria	*Assessment Evidence*
	PERFORMANCE TASK(S):
	OTHER EVIDENCE:

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Language Arts Integration	*Mathematics Integration*
● 1.OA.1 Use	• HSN-Q.A.1 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. • HSN-Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling. • HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. • MP.2 - Reason abstractly and quantitatively. • MP.4 - Model with mathematics.

Technology Integration	***District Materials***
• 1.OA.1 Use	
Science and Engineering Practices	
S&EP 2. Developing and using models S&EP 3. Planning and carrying out investigations S&EP 4. Analyzing and interpreting data S&EP 6. Constructing explanations (for science) and designing solutions (for engineering) S&EP 7. Engaging in argument from evidence S&EP 8. Obtaining, evaluating, and communicating information	