# 2022 Unit 5 Weather and Climate

Content Area: **Science**
Course(s): **Environmental Science**
Time Period: **April**
Length: **full year**
Status: **Published**

## Unit Summary

In this unit of study, students *evaluate claims, analyze and interpret data*, and *develop and use models* to explore the core ideas centered on the Earth's climate system. Students evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by the atmosphere and Earth's various surfaces. They apply these core ideas when they use a quantitative model to describe how variations in the flow of energy into an out of the Earth's systems result in changes in climate, and how carbon is cycle through all of the Earth's spheres. They analyze geoscience data to make the claim that one change to Earth's surface can cause changes to other Earth systems, such as the climate system. Finally, students 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. The crosscutting concepts of *cause and effect, stability and change, energy and matter, and structure and function* arecalled out as an organizing concept for these disciplinary core ideas.

This unit is based on HS-ESS2-4, HS-PS4-4, HS-ESS2-2, HS-ESS2-6, HS-ESS1-4, and HS-ESS3-5.

## Student Learning Objectives (Performance Expectations)

- Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.] (HS-ESS2-6) (This SLO is repeated here and can also be found in Capstone Science Unit 3)

- 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. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.] (HS-ESS3-5)

- Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.] (HS-ESS2-2) (This SLO is repeated here and can also be found in Capstone Science Unit 3)

- Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the

orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.] (HS-ESS2-4)

## Science & Engineering Practices

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| SCI.9-12.SEP.1 | Asking Questions and Defining Problems |
| SCI.9-12.SEP.1.a | Ask questions |
| SCI.9-12.SEP.1.a.1 | that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. |
| SCI.9-12.SEP.1.b | Evaluate a question to determine if it is testable and relevant. |
| SCI.9-12.SEP.1.c | Ask questions 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. |
| SCI.9-12.SEP.1.d | Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. |
| SCI.9-12.SEP.6 | Constructing Explanations and Designing Solutions |
| SCI.9-12.SEP.6.d | Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. |
| SCI.9-12.SEP.7 | Engaging in Argument from Evidence |
| SCI.9-12.SEP.7.e | Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. |
| SCI.9-12.SEP.8 | Obtaining, Evaluating, and Communicating Information |
| SCI.9-12.SEP.8.a | 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. |
| SCI.9-12.SEP.8.c | Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. |

## Disciplinary Core Ideas

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| SCI.9-12.HS-ESS2-4.2 | Cause and effect: Mechanism and explanation. |
| SCI.9-12.HS-ESS2-4.2.1 | students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects. |
| SCI.9-12.HS-ESS2-6.5 | Energy and matter: Flows, cycles, and conservation. |
| SCI.9-12.HS-ESS2-6.5.1 | students learn that the total amount of energy and matter in closed systems is conserved. They can describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of |

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| | protons plus neutrons is conserved. |
| SCI.9-12.HS-ESS3-3.7 | Stability and change. |
| SCI.9-12.HS-ESS2-2.7 | Stability and change. |
| SCI.9-12.HS-ESS2-7.7 | Stability and change. |
| SCI.9-12.HS-ESS2-7.7.1 | students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability. |
| SCI.9-12.HS-ESS2-2.7.1 | Feedback (negative or positive) can stabilize or destabilize a system. |
| SCI.9-12.HS-ESS3-3.7.1 | Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. |
| SCI.9-12.HS-ESS2-7.ESS2.D | Weather and Climate |
| SCI.9-12.HS-ESS2-2.ESS2.D | Weather and Climate |
| SCI.9-12.HS-ESS2-4.ESS2.D | Weather and Climate |
| SCI.9-12.HS-ESS3-6.ESS2.D | Weather and Climate |
| SCI.9-12.HS-ESS2-6.ESS2.D | Weather and Climate |
| SCI.9-12.HS-ESS2-4.ESS2.D.1 | 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. |
| SCI.9-12.HS-ESS3-6.ESS2.D.1 | Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. |
| SCI.9-12.HS-ESS2-6.ESS2.D.1 | Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. |
| SCI.9-12.HS-ESS2-7.ESS2.D.1 | Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. |
| SCI.9-12.HS-ESS2-2.ESS2.D.1 | 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. |
| SCI.9-12.HS-ESS2-6.ESS2.D.2 | Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. |
| SCI.9-12.HS-ESS2-4.ESS2.D.2 | Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. |
| SCI.9-12.HS-ESS2-7.ESS2.E | Biogeology |
| SCI.9-12.HS-ESS2-7.ESS2.E.1 | 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. |
| SCI.9-12.HS-ESS3-3.ESS3.C | Human Impacts on Earth Systems |
| SCI.9-12.HS-ESS3-3.ESS3.C.1 | The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. |
| SCI.9-12.HS-ESS3-6.ESS3.D | Global Climate Change |
| SCI.9-12.HS-ESS3-6.ESS3.D.1 | 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. |

## Cross Cutting Concepts

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| SCI.9-12.HS-ESS1-5.1.1 | Empirical evidence is needed to identify patterns. |
| SCI.9-12.HS-ESS2-4.2.1 | students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects. |
| SCI.9-12.HS-ESS2-6.5.1 | students learn that the total amount of energy and matter in closed systems is conserved. They can describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. |
| SCI.9-12.HS-ESS2-3.5.1 | Energy drives the cycling of matter within and between systems. |
| SCI.9-12.HS-ESS1-6.7.1 | students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability. |
| SCI.9-12.HS-ESS2-2.7.1 | Feedback (negative or positive) can stabilize or destabilize a system. |
| SCI.9-12.HS-ESS2-1.7.1 | Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. |

## Unit Sequence

Part A: Enduring Questions:

- What happens if we change the chemical composition of our atmosphere?

Concept List:

- 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.
- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes.
- 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.
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
- Science arguments are strengthened by multiple lines of evidence

Formative Assessment List:

- Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- Use empirical evidence to differentiate between how variations in the flow of energy into and out of Earth's systems result in climate changes.
- Use multiple lines of evidence to support how variations in the flow of energy into and out of Earth's systems result in climate changes.

Part B: Enduring Questions:

- How does carbon cycle among the hydrosphere, atmosphere, geosphere, and biosphere?

Concept List:

- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
- The total amount of energy and matter in closed systems is conserved.
- The total amount of carbon cycling among and between the hydrosphere, atmosphere, geosphere, and biosphere is conserved.

Formative Assessment List:

- Develop a model based on evidence to illustrate the biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere, providing the foundation for living organisms.

Part C: Enduring Questions:

- How do changes in the geosphere effect the atmosphere?

Concept List:

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.
- 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.
- Feedback (negative or positive) can stabilize or destabilize a system.
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Formative Assessments:

- Analyze geoscience data using tools, technologies, and/or models (e.g., computational, mathematical) to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

Part D: Enduring Questions:

- What happens to solar energy as it moves through the atmosphere and strikes a surface?

Concept List:

- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.
- Cause-and-effect relationships can be suggested and predicted for electromagnetic radiation systems when matter absorbs different frequencies of light by examining what is known about smaller scale mechanisms within the system.

Formative Assessment:

- Evaluate the validity and reliability of multiple claims in published materials about the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
- Suggest and predict cause-and-effect relationships for electromagnetic radiation systems when matter absorbs different frequencies of light by examining what is known about smaller scale mechanisms within the system.

Part E: Enduring Questions:

- What is the current rate of global or regional climate change and what are the associated future impacts to Earth's systems?

Concept List:

- Although the magnitude of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
- Change in rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Science investigations use diverse methods and do not always use the same set of procedures to obtain data.
- Science knowledge is based on empirical evidence.

Formative List:

- Analyze geosciences 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.
- Quantify and model change and rates of change in geosciences data and rates of global or regional climate change and associated impacts to Earth systems.

- Concept List:
- Concept List:
- Formative Assessments:
- Concept List:
- Formative Assessment:
- Although the magnitude of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
- Analyze geoscience data using tools, technologies, and/or models (e.g., computational, mathematical) to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

- Analyze geosciences 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.
- Cause-and-effect relationships can be suggested and predicted for electromagnetic radiation systems when matter absorbs different frequencies of light by examining what is known about smaller scale mechanisms within the system.
- Change in rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
- Concept List:
- Concept List:
- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes.
- Develop a model based on evidence to illustrate the biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere, providing the foundation for living organisms.
- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.
- Evaluate the validity and reliability of multiple claims in published materials about the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
- Feedback (negative or positive) can stabilize or destabilize a system.
- Formative Assessment List:
- Formative Assessment List:
- Formative List:
- How do changes in the geosphere effect the atmosphere?
- How does carbon cycle among the hydrosphere, atmosphere, geosphere, and biosphere?
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
- Part A:  Enduring Questions:
- Part B:  Enduring Questions:
- Part C:  Enduring Questions:
- Part D:  Enduring Questions:
- Part E:  Enduring Questions:
- Quantify and model change and rates of change in geosciences data and rates of global or regional climate change and associated impacts to Earth systems.
- Science arguments are strengthened by multiple lines of evidence
- Science investigations use diverse methods and do not always use the same set of procedures to obtain data.
- Science knowledge is based on empirical evidence.
- Suggest and predict cause-and-effect relationships for electromagnetic radiation systems when matter absorbs different frequencies of light by examining what is known about smaller scale mechanisms within the system.
- 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.

- 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.
- 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.
- The total amount of carbon cycling among and between the hydrosphere, atmosphere, geosphere, and biosphere is conserved.
- The total amount of energy and matter in closed systems is conserved.
- Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- Use empirical evidence to differentiate between how variations in the flow of energy into and out of Earth's systems result in climate changes.
- Use multiple lines of evidence to support how variations in the flow of energy into and out of Earth's systems result in climate changes.
- What happens if we change the chemical composition of our atmosphere?
- What happens to solar energy as it moves through the atmosphere and strikes a surface?
- What is the current rate of global or regional climate change and what are the associated future impacts to Earth's systems?
- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X- rays, gamma rays) can ionize atoms and cause damage to living cells

## Standards

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| SCI.HS-ESS3-1 | Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity. |
| SCI.HS-ESS3-4 | Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems. |
| SCI.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). |
| SCI.9-12.HS.ES | Earth's Systems |
| SCI.9-12.HS.HI | Human Sustainability |
| SCI.9-12.HS.WC | Weather and Climate |
| SCI.9-12.HS-ESS3-3 | Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. |
| SCI.9-12.HS-ESS3-2 | Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. |
| SCI.9-12.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. |
| SCI.9-12.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. |

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| SCI.9-12.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. |
| SCI.9-12.HS-ESS2-6 | Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. |

## Interdisciplinary Connections:

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| TECH.8.1.12 | Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. |
| TECH.8.1.12.A | Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations. |
| TECH.8.1.12.A.CS1 | Understand and use technology systems. |
| TECH.8.1.12.E | Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. |
| TECH.8.1.12.E.CS2 | Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media. |
| TECH.8.1.12.E.CS4 | Process data and report results. |
| TECH.8.1.12.F | Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. |
| TECH.8.2.12 | Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. |
| TECH.8.2.12.A | The Nature of Technology: Creativity and Innovation: Technology systems impact every aspect of the world in which we live. |
| TECH.8.2.12.A.2 | Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste. |
| TECH.8.2.12.A.CS1 | The characteristics and scope of technology. |
| TECH.8.2.12.A.CS2 | The core concepts of technology. |

## 21st Century Skills and Career Ready Practices

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| CRP.K-12.CRP1 | Act as a responsible and contributing citizen and employee. |
| CRP.K-12.CRP1.1 | Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good. |
| CRP.K-12.CRP2 | Apply appropriate academic and technical skills. |
| CRP.K-12.CRP2.1 | Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between |

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| | abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation. |
| CRP.K-12.CRP5 | Consider the environmental, social and economic impacts of decisions. |
| CRP.K-12.CRP5.1 | Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization. |
| CRP.K-12.CRP8 | Utilize critical thinking to make sense of problems and persevere in solving them. |
| CRP.K-12.CRP8.1 | Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others. |
| CRP.K-12.CRP11 | Use technology to enhance productivity. |
| CRP.K-12.CRP11.1 | Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals. |
| CRP.K-12.CRP11.1 | Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks. |

## ELA/Literacy & Math Standards

- • Cite specific textual evidence related to our knowledge of feedbacks in the Earth system, attending to the research methodologies the author employed to generate the evidence
- • Refer to journal articles related to a component of the climate system, synthesize the information and tie it back to the research back to the functioning of the entire climate system.
- • Represent symbolically an explanation for how variations in the flow of energy into and out of Earth's systems result in changes in climate, and manipulate the representing symbols. Use symbols to make sense of quantities and relationships about how variations in the flow of energy into and out of Earth's systems result in changes in climate, symbolically and manipulate the representing symbols.
- • Represent symbolically the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere, and manipulate the representing symbols. Make sense of quantities and relationships in the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

## Lesson Titles

- Air Pollution

- Climate Definition
- Climate Factors
- Global Warming

## Warm-up

- Current Event
- Other
- Review Question
- Vocabulary Tier 2
- Vocabulary Tier 3

## Anticipatory Set

- Question Prompt
- Current Event
- Demonostration
- KWL
- Opening Question on the topic
- Other
- Picture Prompt
- Use of Models
- Video

## What it Looks Like in the Classroom (Instructional Strategies/Learning Activities/DOK)

- Acid Rain Lab
- Concentration of Greenhouse Gasses Activity
- Convection Currents/Coriolis Effect Act. Sht.
- Factors that Influence Climate Activity Sht.
- Global Air Pollution Chromebook Activity
- Graphing Climate of Three Cities Act.
- Latitude/Altitude Act. Sheet
- Milankovitch Cycles Chromebook Act.
- NJ Climate Change Activity
- Particulate Matter Lab
- Rain Shadow Effect Activity Sht.
- Read/Answer Questions on a Current Event Article
- Seasons Chromebook Activity

- Seasons Lab
- Tree Ring Activity

## Closure

- One sentence summary of what was learned
- Exit question
- Other
- Review of lesson
- Summary of lesson

## Modifications

### ELL Modifications

- Give Guided Notes specific to Unit 5 Slides
- Google Translate for notes and assessments
- Visuals: Maps of Weather symbols, Coastal Erosion, CO2 vs temperature graphs, Ice Pack melting comparison
- Tap prior knowledge

### 504 and IEP Accommodations & Modifications

- Graphic organizers/Guided Notes: specific to the Climate Slides on Google Classroom
- Hands on Activities modeling and demonstrating Climate Change and Sea level rise, air pollution in the school with Particulate Matter Catchers
- Teaching the main ideas/concepts of what creates weather, what affects climate and the effects of climate change and repeating them in several different ways over several different days

### Gifted and Talented Modifications

- Inquiry based learning: TheThingamabob Global Warming Game
- Independent project: Helping to Solve the Problem of Global Climate Change

- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tools, experts from the community, journal articles, etc.).
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, etc.)
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Provide English Language Learners students with multiple literacy strategies.
- Provide multiple grouping opportunities for students to share their ideas and to encourage work

among various backgrounds and cultures.

- Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)
- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Structure the learning around explaining or solving a social or community-based issue.

## Benchmark Assessments

Skills-based assessment

Reading response

Writing prompt

Lab practical

## Summative Assessment

- Lab Reports
- M.P. Exams
- Other
- Quizzes
- Tests

## Alternative Assessments

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

## Sample of Open Education Resources

- Acid Rain:http://tinyurl.com/2e7k3z9
- Global Air Pollution: :  http://tinyurl.com/j2xv4nu
- Milankovitch Cycles:  http://tinyurl.com/jpmudck
- NJ Climate:  http://www.nj.gov/dep/dsr/trends/pdfs/climate-change.pdf
- Seasons:  http://tinyurl.com/2ddtuvn

## Resources & Materials

Reason for the Seasons

https://www.youtube.com/watch?v=iXY79qBxovE

India's Air Pollution Article

https://drive.google.com/open?id=0BxtxTZFGOH0aeUNwd2tpRlFBOU0

Sea level Rise Interactive

https://coast.noaa.gov/digitalcoast/tools/slr

Virtual Acid Rain Lab: http://tinyurl.com/ayryc8x

## Technology

- Microscopes
- 1:1 Technology
- Smart Notebook
- Powerpoint
- Google Docs/slides/Sheets
- Various lab equipment