Unit 3b Weather and Climate

Content Area: **Science**
Course(s): **Science 7**
Time Period: **Marking Period 3**
Length: **MP 3**
Status: **Published**

Essential Questions

- How does fresh water cycle on Earth?
- What causes ocean currents?
- How does the sun's energy affect Earth's atmosphere?
- How do meteorologists predict weather?
- What factors affect Earth's climate?
- How is Earth's weather produced?
- How is climate different from weather?

Big Ideas

- Earth's land, water, air and life forms a system.
- Human activities can change earth's land, water, air and life.
- Water circulates through earth's crust, ocean, and atmosphere in the water cycle.
- Weather and climate are the result of the interactions among earth's water, its atmosphere and the sun's heating of Earth's surface.

Cross-Curricular Integration

Integration Area: Language Arts

W.IW.7.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

A. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using text structures (e.g., definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g., headings, graphics, and multimedia) when useful to aid in comprehension.

B. Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.

C. Use appropriate transitions to create cohesion and clarify the relationships among ideas and concepts.

D. Use precise language and domain/ grade-level- specific vocabulary to inform about or explain the topic.

E. Establish and maintain a formal style academic style, approach, and form.

F. Provide a concluding statement or section (e.g., sentence, part of a paragraph, paragraph, or multiple paragraphs) that follows the flow of ideas, reflects back on the topic, and supports the information or explanation presented.

Activity:

Students will write CERs (Claim, Evidence & Reason) on Climate Change. Students will be able to convey their thinking and decision making in written form.

- Students will be answering the question, "What are the contributors of climate change?"
- Students provide evidence that supports their claim.
- Students will then write a reasoning that explains what their claim is, state knowledge they have on the topic, evidence to prove their topic, and close their reasoning with their claim again.

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RL.CR.7.1. Cite several pieces of textual evidence and make relevant connections to support analysis of what a literary text says explicitly as well as inferences drawn from the text.

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RL.CI.7.2. Determine a theme in a literary text (e.g., stories, plays or poetry) and explain how it is conveyed

through particular details; provide a summary of the text distinct from personal opinions or judgments.

RI.CI.7.2. Determine a central idea in an informational text and explain how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

RL.IT.7.3. Analyze how particular elements of a text interact including how particular lines of dialogue or incidents in a story or drama propel the action, reveal aspects of a character, or provoke a decision.

RL.MF.7.6. Compare and contrast texts (e.g., a written story, drama, or poem) to its audio, filmed, staged, or multimedia version and analyze the unique qualities of different mediums, including the effects of techniques unique to each medium (e.g., lighting, sound, color, or camera focus and angles in a film).

Activity:

Weather: Explain both the greenhouse effect and the theory of global warming. Do you believe there is a relationship between the greenhouse effect and global warming? Use at least three sources of evidence to support your claim. What impact, if any, does global warming have on your life? Be sure to include at least two relevant examples from your personal experience. What impact do these two things have on your life? Write an explanatory essay that uses fact, details and examples to explain each theory and their relationship to each other.

Chapter 6: Percents

7.RP.A.3 Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

Science and Engineering Practices

Asking Questions and Defining Problems

- Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5)

Developing and Using Models

- Develop and use a model to describe phenomena. (MS-ESS2-6)

Planning and Carrying Out Investigations

- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)

CSDT Technology Integration

8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.

8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results.

Activity:

Students record the weather outside on a spreadsheet, using materials created in the classroom or provided by the STEM lab and compare them to reports of previous years. The data from the previous years will be researched from internet sources. The data from this year and the data from 20, 40, 60, 80, and 100 years ago will be placed on a table and will also require a creation of a graph indicating temperatures over the years. Students will explain how the climate has changed over the course of 100 years.

Enduring Understandings

MS. Earth's Systems

MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation for the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

MS. Earth and Human Activity

MS- ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Disciplinary Core Ideas

ESS2.C: The Roles of Water in Earth's Surface Processes

- 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)
- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)
- Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)

- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)

ESS3.D: Global Climate Change

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

Crosscutting Concepts

Stability and Change

Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

(MS-ESS3-5)

Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS- ESS2-5)

Systems and System Models

Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6)

Energy and Matter

Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

Focus Areas

Fresh Water

- All living things need water in order to carry out their body processes. In addition, many living things live in water.
- Most of the Earth's surface water – roughly 97 percent – is salt water found in oceans. Only 3 percent

is fresh water.
- In the water cycle, water moves between land, living things, bodies of water on Earth's surface, and the atmosphere.

The Oceans

- Surface currents are driven mainly by winds. A surface current warms or cools the air above it, affecting the climate of the land near the coast.
- Deep currents are caused by differences in the density of ocean water. They move and mix water around the world and carry cold water from the poles toward the equator.

The Atmosphere

- Earth's atmosphere consists of nitrogen, oxygen, carbon dioxide, water vapor, and other gases, as well as particles of liquids and solids.
- Events in one part of the atmosphere affect other parts of the atmosphere.
- Air pressure decreases as altitude increases. As air pressure decreases, so does density.
- Scientists divide Earth's atmosphere into four main layers according to changes in temperature.
- Earth's weather occurs in the troposphere. The stratosphere contains the ozone layer.
- Heat is transferred in three ways: convection, conduction and radiation.
- Winds are caused by differences in air pressure.

Weather, Climate and Climate Change

- Weather is what conditions of the atmosphere are over a short period of time, and climate is how the atmosphere "behaves" over relatively long periods of time.
- Meteorologists use maps, charts, computers, and other technology to prepare weather forecasts.
- Scientists classify climates according to two major factors: temperature and precipitation.
- The six main climate regions are tropical, rainy, dry, temperate marine, temperate continental, polar and highlands.
- In studying ancient climates, scientists follow an important principle: If plants and animals today need certain conditions to live, than similar plants and animals in the past also required those conditions.
- Possible explanations for major climate changes include movement of continents, variations in the position of Earth relative to the sun, major volcanic eruption, and changes in the sun's energy output.
- Many human activities are increasing the level of greenhouse gases in the atmosphere, causing global temperatures to rise.
- Global warming refers only to the Earth's rising surface temperature, while climate change includes warming and the "side effects" of warming—like melting glaciers, heavier rainstorms, or more frequent drought. Said another way, global warming is one symptom of the much larger problem of human-caused climate change.
- Solutions for limiting global warming include finding clean, renewable sources of energy, being more energy efficient, and removing carbon from fossil fuel emissions.
- Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
- Multiple solutions often exist to solve a problem.
- An essential aspect of problem solving is being able to self-reflect on why possible solutions for solving problems were or were not successful.
- Digital technology and data can be leveraged by communities to address effects of climate change.
- Sources of information are evaluated for accuracy and relevance when considering the use of information.

Energy and Matter

(MS-ESS2-4) Within a natural or designed system, the transfer of energy drives the motion and/or recycling of matter.

Creativity and Innovation

9.4.8.CI.1: Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

9.4.8.CI.2: Repurpose an existing resource in an innovative way.

9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas.

9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries.

Critical Thinking and Problem-Solving

9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective.

9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.

9.4.8.CT.3: Compare past problem-solving solutions to local, national or global issues and analyze the factors that led to a positive or negative outcome.

Digital Citizenship

9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).

Information and Media Library

9.4.8.IML.8: Apply deliberate and thoughtful search strategies to access high-quality information on climate change.

6-8 Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the

natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)
- Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

*See Appendix E for Cross Content

Climate Change

MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

- Activity: Develop and explain a model that describes the cycling of water throughout the system, driven by energy from the sun and the force of gravity. Create a detailed diagram of the water cycle, including labels for each process (Evaporation, condensation, precipitation, transpiration, and runoff). Write a short explanation (1-2 paragraphs) describing how the sun's energy and gravity drive these processes. Students will also include how climate change effects the water cycle.

MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

- Activity: Collect and analyze data to explain how the motions and interactions of air masses result in changes in weather conditions. Create a weather forecast presentation that includes: 1. A map showing the movement of air masses. 2. Predictions of weather changes based on air mass interactions. 3. An explanation of how they used data to make their predictions. 4. A discussion of the probabilistic nature of weather forecasting.

MS-ESS2-6: Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

- Activity: Develop and use a model to explain how unequal heating and Earth's rotation create patterns of atmospheric and oceanic circulation that determine regional climates. Create a digital or physical model demonstrating Earth's atmospheric and oceanic circulation patterns. Write a brief explanation (1-2 paragraphs) describing how these patterns are influenced by unequal heating and Earth's rotation, and how they can affect regional climates. Students could look at the past 5 years of hurricane activity in a specific area of their choice. Students can predict the trends for the next few years.

MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused climate change over the past century.

- Activity: Analyze the evidence of human activities contributing to climate change, explain the role of greenhouse gases in global warming, and evaluate potential solutions to mitigate climate change impacts. Create a digital presentation or poster that: (1) Identifies at least 3 human activities contributing to climate change. (2) Explains how these activities release greenhouse gases. (3) Presents evidence of global warming over the past century. (4) Proposes two realistic solutions to reduce human impact on climate change. (5) Includes a brief explanation of how their proposed solutions could help mitigate climate change.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

- Activity: Define the criteria and constraints for designing a climate-resilient community, considering

scientific principles, potential impacts on people, and the natural environment. Students can be assessed by Create a detailed proposal for a climate-resilient community design. The proposal should include: (1) A list of a least 5 criteria for the design (e.g., energy efficiency, flood protection, heat mitigation). (2) A list of a least 5 constraints (e.g., budget, available materials, local regulations). (3) An explanation of how each criterion and constraint relates to scientific principles of weather and climate. (4) A discussion of potential impacts on different population groups and the natural environment. (5) A sketch or diagram of the proposed community design.

MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

- Activity: Analyze and compare multiple design solutions for climate change mitigation, identify the best characteristics of each, and combine them to create an improved solution using data analysis and the Pythagorean theorem. Design, test, and evaluate three different solutions for reducing carbon emissions in their local community. They can collect data on each solution's effectiveness, use the Pythagorean theorem to calculate the impact on population distribution, and create a final report that: (1) Analyzes the data from each solution. (2) Identifies the best characteristics of each design. (3) Proposes a new, optimized solution that combines the best elements. (4) Justifies their choices using data and mathematical calculations.

MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved.

- Activity: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process to achieve an optimal design related to climate change mitigation. Design a simple wind turbine model using readily available materials (e.g., paper, cardboard, straws). They will then test their model, collect data on its performance, modify the design based on test results, and repeat the process to optimize their wind turbine's efficiency. Students will submit a report detailing their initial design, test results, modifications, and final optimized design, along with a graph showing the improvement in performance over iterations.

Career Readiness

9.4.8.CI.1: Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.

- Activity: Gather, evaluate, and analyze data from diverse sources on the causes of climate change, considering global perspectives, and use this information to design multiple potential solutions. Create a multimedia presentation that: (1) Showcases data collected from at least three diverse sources representing different cultural, gender, or generational perspectives on climate change causes. (2) Evaluates the credibility and relevance of each source. (3) Synthesizes the information to propose two innovative solutions to address climate change. (4) Explains how the diverse perspectives influenced their proposed solutions.

9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change and use critical thinking skills to predict which one(s) are likely to be effective.

9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).

- Activity: Evaluate multiple solutions to a local or global problem, such as climate change, and use critical thinking skills to predict which solution(s) are likely to be most effective in both the short and long term. Create a presentation comparing and contrasting three different solutions to a chosen local or global problem. Evaluate each solution's potential effectiveness in the short and long term, considering factors such as feasibility, cost, and environmental impact. Students will then use critical thinking skills to predict which solution is likely to be most effective and explain their reasoning.

9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).

- Activity: Students may be able to evaluate sources of information for accuracy and relevance, apply deliberate search strategies to access high-quality information on climate change, and use information from diverse sources for a specific purpose. Students can be assessed by creating a research portfolio on a specific aspect of climate change. The portfolio will include: (1) A list of at least 5 diverse, high-quality sources. (2) A brief evaluation of each source's accuracy and relevance (3) A summary of the search strategies used to find the sources (4) A 2-page report synthesizing the information for a specific purpose (e.g., informing local policymakers about climate change impacts)

Resources

Savvas Interactive Science - Water and Atmosphere - 2016

Scientific Inquiry

MS-ESS2-4 *Water Cycle in a Jar*
MS-ESS2-5 *Weather Scope Real Time Data*
MS- ESS3-5 *Which Location is Best for Me*