NGSS Storyline Sample

<table>
<tr><th colspan="2">Organisms and Their Environments</th></tr>
<tr><td>Storyline Summary
Students begin the unit by exploring desert organisms and identifying what resources they rely on and how these organisms interact. Water is identified as a primary resource that ALL organisms need to survive, and the focus of the unit shifts to where water can be found on Earth and how it moves through Earth's systems, particularly focusing on water in the Mojave Desert.</td><td>MS-ESS2-4, MS-ESS2-5, MS-ESS2-6, MS-LS2-1, MS-LS2-2</td></tr>
<tr><td>Anchor Phenomenon: Wildlife On The Move</td><td>Engage Activity
Students will choose a bird from the Audubon site (https://climate.audubon.org/geographical-search) whose range will likely be affected by climate change. Students will map the predicted changes for their species and participate in a gallery walk to observe predicted changes for other species. Students will generate questions about the predicted changes, such as: Why are the ranges changing? Why are many moving North? What are the major factors that determine a species' range? What are the major factors that determine where species will likely move? How did they make these predictions? Why do different places have different climates? (This is not a comprehensive list of student questions.)</td></tr>
<tr><td colspan="2">Sequence 1: Desert Life and Water Resources</td></tr>
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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.** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [*Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.*]	**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. Global movements of water and its changes in form are propelled by sunlight and gravity.	**Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. **Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.
MS-LS2-1 **Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. Growth of organisms and population increases are limited by access to resources.	**Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena. **Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
02 Phenomenon: Asking Questions About Desert Environments > Climate Brain Dump Students will "braindump" what they know about climate. What is climate? What types of "climates" are there? What affects climate? > Mapping Deserts Students will be given a map of the world, and they will shade where they think deserts can be found. They will list some of the	*Objectives:* → Students will make observations about desert environments. → Students will ask questions about the diversity of desert environments.	Asking Questions and Defining Problems Patterns

organisms they think they might find there. They will update their maps with the accurate locations of Earth's deserts to keep as a reference. Then, students will be challenged by observing pictures of deserts that may not fit the vision in their head -- pictures of the Atacama Desert in bloom, Antarctica, desert oases, and coastal deserts (Namib Desert). They will generate questions about each of these scenarios. > Virtual Tour: The Mojave Desert Students will browse photos from https://www.nps.gov/moja/learn/photosmultimedia/virtualtour.htm and choose three from which they will record ten observations about the Mojave Desert ecosystem. Students will share their photos and observations and compare these to other students. Students will generate questions about the Mojave Desert.		
03 Exploring Desert Life > Profiles of Desert Life Students will research an organism native to the Mojave Desert and create a profile of the organism in order to participate in a "speed dating" activity. > Desert Speed Dating Students will rotate through "dates" with other organisms native to the Mojave Desert in order to understand both the different and shared needs of organisms and the ways they interact in order to survive.	*Objectives:* → Students will synthesize information from several sources to create a profile of a desert organism and the living and nonliving factors it interacts with and depends on. *Objectives:* → Students will compare and contrast the needs of desert organisms. → Students will identify and describe ways organisms interact with other things in the ecosystem.	Obtaining, Evaluating, and Communicating Information Systems and System Models Patterns

> Understanding Ecosystems Students will use a digital text (or course textbook) to create a graphic organizer about the organization of ecosystems. They will record unit vocabulary using an INB organizer. Supplementary Material: *Exploring Biotic and Abiotic Factors*	*Objectives:* → Students will identify the components of ecosystems using appropriate terminology. (Vocabulary: organism, population, community, ecosystem, biotic factor, abiotic factor)	
04 Phenomenon: Flash Flood In The Desert > Photo Analysis: Flash Flood In The Desert Students will examine a photo of a flash flood, generating ideas of where it could have occurred and what caused it to occur (using evidence from the photo to support their ideas). > Text Analysis Students will read a short text that summarizes the climate of the Mojave Desert and ties the photograph to a desert flash flood. [Through the next instructional sequence, students will investigate the water cycle in the desert to answer these questions.]	*Objectives:* → Students will generate questions about the causes of a flash flood in the desert.	Asking Questions and Defining Problems Change and Stability
05 The Water Cycle: A Drop In The Desert > A Water Story Students will participate in a role-play to identify where water can be found on Earth. > Water Cycle Simulation: Journey Of A Drop Through a simulation, students will track how	*Objectives:* → Students will identify sources of water in the desert through a story/role-play. *Objectives:* → Students will track how water moves in the desert through a simulation.	Developing and Using Models Systems and System Models Energy and Matter

water (matter) moves through Earth's systems - driven by energy from the sun and the force of gravity. Students will focus their model-building on water in the desert.	→ Students will work in groups to develop a model of how water moves in the desert.	
06 Energy and Matter In The Water Cycle > Exploring Evaporation > Exploring Condensation Students will participate in two labs to understand how energy is also moving through the water cycle -- absorbed, released, and carried away during water cycle processes but never lost or destroyed.	*Objectives:* → Students will develop a model to illustrate how energy moves during evaporation. → Students will develop a model to illustrate how energy moves through the water cycle processes of evaporation and condensation.	Developing and Using Models Energy and Matter
07 Formative Assessment: Flash Flood In The Desert Students will return to the initial phenomenon (flash flood in the desert) and use what they have learned about the water cycle to describe where the water came from and where it will go.	*Objectives:* → Students will apply their understanding of the water cycle to explain the flash flood in the desert, identifying where water came from and where it will go.	Developing and Using Models Systems and System Models
08 Phenomenon: Will WWIII Be Fought Over Water? Students will consider and respond to the question, "Will WWII Be Fought Over Water?" Suggested Resource: NPR Will The Next War Be Fought Over Water?	*Objectives:* → Students will activate prior knowledge about water as a natural resource by engaging in a discussion over a contentious claim, that the next world war will be fought over water. → Students will communicate their initial ideas and understandings through class discussion (when possible referring to evidence from previous experiences or learning activities).	Obtaining, Evaluating, and Communicating Information Engaging In Argument From Evidence Systems and System Models
09 Water As A Natural Resource > Understanding Water Scarcity	*Objectives:* → Students will explore the distribution of	Developing and Using Models Obtaining, Evaluating, and Communicating

Students will construct a model to illustrate the limited availability of freshwater on Earth. > Exploring Groundwater Resources Students will investigate where groundwater resources can be found in the United States. They will construct a model of an aquifer to investigate how aquifers work and the impact of water withdrawal on aquifers. > Understanding Groundwater and Aquifers Students will obtain information from a text to synthesize their understanding of groundwater resources. *Extension Resources:* >> *Exploring Groundwater and Aquifers* >> *Investigating the Structure of Aquifers (Porosity and Permeability)*	water on Earth by developing a model. *Objectives:* → Students will explore the availability of groundwater in the United States. → Students will develop a model to investigate the use and recharge of aquifers. → Students will use their model to draw conclusions about water usage of communities in southern California. *Objectives:* → Students will obtain information to communicate how aquifers are a source of water for many communities in the United States. → Students will obtain information to communicate how human activity can impact groundwater resources.	Information Systems and System Models Stability and Change
10 The Water Cycle: Using Scientific Texts Students will read a scientific text adapted for classroom use to obtain information about shrinking glaciers in Asia. They will answer analysis questions to determine the purpose, methods, and results of the investigations and connect the studies to the DCI, and then they complete one of two graphic organizers to examine how the "lens" through which phenomena are examined can impact our understanding.	*Objectives*: → Students will read scientific texts to determine central ideas about a scientific investigation. → Students will read scientific texts to obtain information about human impacts on water resources.	Obtaining, Evaluating, and Communicating Information Planning and Carrying Out Investigations Systems and System Models Stability and Change
11 Water Wars In The Mojave - Using	*Objectives:*	Obtaining, Evaluating, and Communicating

Scientific Texts Students will read two short texts that propose counter-arguments to the issue of withdrawing water from the Fenner Basin in the Cadiz Valley. Students will evaluate the arguments and the evidence provided by each author and assess the situation through the Crosscutting Concept lens of Stability and Change using an additional graphic organizer.	→ Students will compare and critique two arguments on the same topic to analyze whether they emphasize similar or different evidence and/or interpretation of facts.	Information Engaging In Argument From Evidence Stability and Change
12 Formative Assessment: Water Wars Students will return to the initial phenomenon (the potential for conflict over water resources) and use what they have learned about the water cycle and the availability of water to engage in a discussion in which they represent diverse stakeholders.	*Objectives:* → Students will demonstrate their understanding of water issues by representing stakeholders in a mock "community debate" to decide on future action that affects a water resource. → Students will construct a written response based on evidence that argues for or against a specific action.	Obtaining, Evaluating, and Communicating Information Engaging In Argument From Evidence Cause and Effect Stability and Change
13 Phenomenon: The Atacama In Bloom Students will examine images or video (see suggested resources) of the Atacama Desert in bloom. They will generate ideas about what could have caused this phenomenon. Suggested Resources: Video: Chile Flowering Desert Text/Photos: BBC Chile's Desert Blooms	*Objectives:* → Students will generate questions and potential explanations about the phenomenon observed.	Asking Questions and Defining Problems Cause and Effect
14 Resource Availability: Water In The Desert > The Availability of Water Students will rotate through stations at which they analyze data to make connections between the resource availability (availability	*Objectives:* → Students will analyze data to provide evidence that the availability of water affects plant growth. → Students will analyze data to provide evidence that the availability of water affects	Analyzing and Interpreting Data Engaging In Argument From Evidence Patterns Cause and Effect

of water) and the growth of organisms and populations. > Understanding Resource Availability Students will interact with a text to understand indicators of cause and effect relationships. They will create claims about cause and effect relationships, using evidence obtained in the first activity, and evaluate their claims in light of the cause-and-effect indicators. > Identifying Cause and Effect Relationships Finally, students will use a card sort to connect events and phenomenon and identify what evidence would be necessary to establish and support claims of causal relationships between the events.	populations. → Students will provide evidence to explain how the availability of resources affects the growth of organisms and populations. *Objectives:* → Students will identify the indicators of cause and effect relationships and apply these to a claim. *Objectives:* → Students will examine events and engage in argument to identify possible causal relationships. → Students will identify the evidence needed to support a causal claim.	
15 Resource Availability - Using Scientific Texts Students will read two scientific texts adapted for classroom use to obtain information about the effects of changes to resource availability on organism growth and populations. They will answer analysis questions to determine the purpose, methods, and results of the investigations and connect the studies to the DCI, and then they complete a Cause and Effect graphic organizer to illustrate their understanding of the causal relationships between the factors in the studies.	*Objectives:* → Students will read scientific texts to determine central ideas about a scientific investigation. → Students will read scientific texts to obtain information in order to provide evidence for the concept that resource availability impacts the growth of organisms and populations.	Obtaining, Evaluating, and Communicating Information Cause and Effect
16 Formative Assessment: The Atacama In Bloom Students will examine images or video (see	*Objectives:* → Students will construct an explanation based on evidence to explain the sudden	Asking Questions and Defining Problems Cause and Effect

suggested resources) of the Atacama Desert in bloom. They will construct an explanation about this phenomenon, using evidence from their learning activities. Suggested Resources: Video: Chile Flowering Desert Text/Photos: BBC Chile's Desert Blooms	bloom of flowers in the Atacama Desert.	
17 Assessment: The Water Cycle & Resource Availability > Assessment 1: Modeling The Water Cycle In The Mojave Students are given a phenomenon via text and develop a model of the water cycle in the Mojave Desert. > Assessment 2: Resource Availability In The Desert Students analyze data (MS-LS2-1) to evaluate the effects of a change in the availability of a resource (water) on the growth and reproduction of organisms and populations (desert tortoises).	*Objectives:* → Students will develop a model to illustrate the movement of water through Earth's systems, driven by energy from the sun and the force of gravity, in the Mojave Desert. → Students will make predictions about the impact of global climate change on water resources in the Mojave Desert. *Objectives:* → Students will analyze data to draw conclusions about the impact of global warming and climate change on desert resources, and in turn, on the behavior and ultimately growth and reproduction of desert tortoises. → Students will use evidence provided, in addition to their own experiences and prior work, to engage in argument from evidence about the potential impact of global climate change on desert tortoise populations.	Developing and Using Models Analyzing and Interpreting Data Engaging in Argument from Evidence Systems and System Models Energy and Matter
Sequence 2 The Mojave Climate (Climate Factors)		
18 Phenomenon: Death Valley - The Hottest	*Objectives:*	Asking Questions and Defining Problems

Place On Earth and the Driest Place In North America Students will examine a map of Death Valley, along with its location and climate statistics, and generate ideas to explain its hot and dry climate and questions to investigate. Suggested Resources: NPR Death Valley NPR Death Valley Map	→ Students will generate questions about Death Valley and the factors that affect its climate.	Cause and Effect
19 Climate Factors: Exploring Data With Climatograms > Exploring Climate Data Students learn how to read a climatogram before creating their own from data provided (or alternatively, collected by students on the blank option). > Categorizing Climate Then, students analyze the climatograms they created (or those you provide from the Answer Keys) to categorize various U.S. cities by climate.	*Objectives:* → Students will analyze climate data to develop an understanding of the diverse climate zones in the United States. *Objectives:* → Students will obtain information from web sources to understand the characteristics of the primary climate zones in the United States.	Analyzing and Interpreting Data Patterns
20 Climate Factors: Latitude (North American Deserts) > Mapping North American Deserts Students map North American deserts and then analyze average temperatures to draw conclusions about the impact of latitude on temperature. > Earth's Tilt and Solar Energy Students then design and carry out an investigation using a simulation to answer	*Objectives:* → Students will organize and analyze data to draw conclusions about temperature differences of North American deserts. *Objectives:* → Students will carry out an investigation using an online simulation to answer the	Designing and Carrying Out Investigations Analyzing and Interpreting Data Patterns

the question, Why does latitude affect temperature? A follow-up demo/simple lab reinforces student understanding of the impact on temperature of the angle at which solar energy hits the Earth. > Solar Energy and Latitude Finally, students read a short text and compile the evidence they have collected to explain the differences in temperatures of North American deserts.	question, Why does latitude affect temperature? *Objectives:* → Students will explain the differences in temperature of North American deserts using what they have learned about latitude and solar output.	
21 Formative Assessment: Death Valley - The Hottest Place On Earth and the Driest Place In North America Students will review what they recorded about Death Valley and apply what they have learned about latitude to evaluate the impact of latitude on the climate in Death Valley. Suggested Resources: NPR Death Valley NPR Death Valley Map	*Objectives:* → Students will construct an explanation based on evidence for the impact of latitude on the climate of Death Valley.	Constructing Explanations and Designing Solutions Cause and Effect
22 Climate Factors: Atmospheric Circulation > Thermal Energy and Particle Motion Students use a simulation to review the relationship between particle motion and thermal energy. > Exploring Convection Then, students carry out an investigation to understand the movement of atmospheric gases via convection. > Understanding The Coriolis Effect	*Objectives:* → Students will develop a model to illustrate the relationship between thermal energy, particle motion, and density. *Objectives:* → Students will observe a phenomenon to draw conclusions about the relationship between density and the movement of fluids. → Students will apply their understanding of convection to atmospheric circulation.	Developing and Using Models Constructing Explanations and Designing Solutions Scale, Proportion, and Quantity Energy and Matter

Finally, students develop a model to understand the role of the Earth's rotation in the movement of air on Earth's surface. They apply their understandings to the phenomena of regional climates.	*Objectives:* → Students will explain how Earth's rotation affects the movement of air around the globe. → Students will use their model to make predictions about the impact of atmospheric circulation on climate patterns.	
23 Climate Factors: Geography (Mountains, Elevation, and Bodies of Water) > Exploring Geography and Climate Students analyze climatograms to identify patterns in precipitation and temperature that lead them to discover the influence of mountains, elevation, and bodies of water on climate. > Understanding Geographical Influences Students then use web resources (or their textbook) in combination with evidence collected during the activity to support claims regarding the influence of geography on climate. > Explaining Climate Patterns Students apply their understanding to explain the climate in a given location (or their own city).	*Objectives:* → Students will analyze data on precipitation and temperature to identify patterns and draw conclusions about the effects of geographical features on climate patterns. *Objectives:* → Students will obtain information from web sources to understand how geography can influence the climate of an area, focusing on the impact of mountains, elevation, and latitude. *Objectives:* → Students will apply their understanding to explain climate patterns in a new location (or your local city).	Analyzing and Interpreting Data Patterns

24 Formative Assessment: Death Valley - The Hottest Place On Earth and the Driest Place In North America Students will review what they recorded about Death Valley and apply what they have learned about geography (altitude, mountains, etc.) to evaluate the impact of these on the climate in Death Valley. They are revising their models to improve their explanation. Suggested Resources: NPR Death Valley NPR Death Valley Map	*Objectives:* → Students will construct an explanation based on evidence for the impact of geography on the climate of Death Valley.	Constructing Explanations and Designing Solutions Cause and Effect
25 Phenomena: London's Crazy Weather Students will discuss London's unpredictable weather. (See this article to provide background information.) They will consider what they have learned about the factors that influence climate to try to explain what they observe. (These factors cannot fully explain what they observe.) Students will identify what cannot yet be explained and generate questions they would like to investigate.	*Objectives:* → Students will generate questions about the climate in London, UK.	Asking Questions and Defining Problems Cause and Effect
26 Climate Factors: Exploring Ocean Currents > Ocean Currents Lab: Temperature & Salinity Students carry out two labs to investigate the role of temperature and salinity differences in the movement of ocean water.	*Objectives:* → Students will carry out an investigation to determine how changes in temperature and salinity can cause fluids to move. *Objectives:* → Students will explain how changes in	Planning and Carrying Out Investigations Systems and System Models Energy and Matter

> Making Sense of Ocean Currents Students apply what they have learned about salinity and temperature to understand the global ocean convection cycle. They will apply this understanding to explaining differences in climate in two locations at high northern latitudes. Resources To Address Necessary Prior Knowledge: Structure and Properties of Matter Density of Liquids Activity	temperature and salinity explain the **global ocean convection cycle.** → Students will explain how the geographical distribution of land limits where ocean currents can flow. → Students will explain how **the global ocean convection cycle** transfers heat from the equator to the poles. → Students will explain how **the global ocean convection cycle** transfers heat from the equator to the poles and influences climate.	
27 Phenomena: London's Crazy Weather Students will return to their discussion of London's unpredictable weather. (See this article to provide background information.) They will apply what they have learned about ocean currents to explain London's relatively warm winters.	*Objectives:* → Students will explain London's climate (particularly its relatively warm winters) in light of what they have learned about factors that influence climate.	Asking Questions and Defining Problems Cause and Effect
28 Assessment: Modeling Earth's Climate In this performance task, students create a model to explain latitudinal climate patterns. Then, they use their model, as well as their understanding of other factors that impact climate (geography, etc) to explain the climate of two locations (selected from eight provided Desert Climate Cards). [Full explanations are provided for teacher background knowledge.]	*Objectives:* → Students will develop a model to illustrate the effects of Earth's tilt and rotation on latitudinal climate patterns. → Students will use their models to describe how atmospheric and oceanic circulation (caused by unequal heating and rotation of the Earth) explain regional climates in two locations.	Developing And Using Models Systems and System Models
Sequence 3: Weather Patterns and Extreme Events		

MS-ESS2-5 **Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.** [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]	**ESS2.C: The Roles of Water in Earth's Surface Processes** 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. **ESS2.D: Weather and Climate** Because these patterns are so complex, weather can only be predicted probabilistically.	**Planning and Carrying Out Investigations** Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. 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 **Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
29 Phenomena: Tornado Warning! Students will discuss their experiences with and prior knowledge of tornadoes. Students will view the data (maps) from the articles below, as well as watch a video about the formation of a tornado. Suggested Resources: National Geographic: Birth Of A Tornado Tornadoes of 2016 SPC Tornadoes By State By Month	*Objectives:* → Students will examine data and videos to generate questions about why, when, and where tornadoes occur in the United States.	Analyzing and Interpreting Data Asking Questions and Defining Problems Patterns
30 Weather Basics > Breaking Down The Weather Forecast Students first collect weather data and use web resources to understand the factors that	*Objectives:* → Students will break down a weather forecast to understand the different components that contribute to weather	Analyzing and Interpreting Data Patterns

contribute to weather conditions. <u>> Atmospheric Conditions and Weather Patterns</u> Then, students analyze data from weather maps to identify patterns and understand how atmospheric conditions contribute to weather. Students use their maps, as well as a real weather forecast map, to explain current weather conditions and predict the weather.	(temperature, sun/cloud cover, precipitation, humidity, air pressure, wind speed). → Students will use web resources to understand each factor and describe how it connects to weather conditions. *Objectives:* → Students will collect data on atmospheric conditions and make connections between conditions and the weather forecasts.	
<u>31 Investigating Thunderstorms and Severe Weather</u> <u>> Stormy Ideas</u> Students evaluate their current understanding of the factors that impact the development of thunderstorms. <u>> Exploring The Formation of Thunderstorms</u> Students use a simulation to investigate the factors that contribute to the development of severe weather. <u>> Modeling The Formation of Thunderstorms</u> Students synthesize prior understanding and new learning to develop a model that illustrates the formation of a thunderstorm.	*Objectives:* → Students will consider their current understanding of thunderstorms and their formation using an anticipation guide. *Objectives:* → Students will make observations and generate questions from a time-lapse video of the formation of an isolated thunderstorm. → Students will apply their prior knowledge of the water cycle to the formation of clouds. → Students will explore the factors that contribute to severe weather through an online simulation. *Objectives:* → Students will expand on their initial models of cloud formation to explain how isolated thunderstorms form. → Students will obtain information from a scientific text to expand on their understanding and revise their models.	Developing and Using Models Energy and Matter
<u>32 Exploring Weather Fronts</u>	*Objectives:*	Asking Questions and Designing Solutions

> Storms On The Map Students analyze and interpret data in the form of weather maps to draw conclusions about the causes of large-scale severe weather events. > Weather and Fronts Students discover how the movement of air masses can result in weather fronts that affect large geographic areas and cause severe thunderstorms. > Global Weather Students apply their understanding to explain the outbreak of severe weather in the Midwest in May of 2019.	→ Students will review how isolated thunderstorms form. → Students will examine a radar map to generate questions about the formation of large-scale severe weather events. *Objectives:* → Students will analyze weather maps to identify relationships between the movement of air masses and the development of severe weather. *Objectives:* → Students will synthesize their understanding of the factors that impact the development of weather.	Analyzing and Interpreting Data Developing and Using Models Stability and Change Patterns
33 Formative Assessment: Tornado Warning! Students will review what they observed about when and where tornadoes occur. At this point, students should focus on *when*. They will generate ideas about why tornadoes (and severe weather generally) occur most often in the spring. Ask students to consider how they might test the ideas they generate. What type of investigation could they carry out to test whether their hypotheses are accurate? Suggested Resources: National Geographic: Birth Of A Tornado Tornadoes of 2016 SPC Tornadoes By State By Month	*Objectives:* → Students will construct an explanation based on evidence to explain the frequency of tornadoes (and severe weather) in the spring.	Constructing Explanations and Designing Solutions Planning and Carrying Out Investigations Cause and Effect
34 Tornadoes and Severe Weather	*Objectives:*	Asking Questions and Designing Solutions

> Tornado Season > Modeling A Tornado > Understanding Tornadogenesis Students investigate the factors that contribute to the development of tornadoes. They apply their understanding of the water cycle, weather, and climate factors to tornadogenesis. Emphasis is on developing and using models (SEP) and the movement of energy and matter (CCC).	→ Students will analyze and interpret data in light of their understanding of weather and climate to develop an explanation for the development of severe weather. →Students will analyze data to develop questions about the factors that contribute to the development of severe weather and tornadoes. *Objectives:* → Students will explore the ingredients of severe storms to develop a model that illustrates how a tornado forms. *Objectives:* → Students will obtain information from several sources to revise their model of tornadogenesis.	Analyzing and Interpreting Data Developing and Using Models Energy and Matter Patterns
35 Air Masses: Types and Source Regions > Air Masses and Source Regions Students identify the source regions for each type of air mass that affects North American weather and use this information to draw conclusions about the characteristics of the air masses. Then, they apply their understanding to solve riddles about the air mass(es) involved in four weather events/phenomena.	*Objectives:* → Students will analyze information about the source regions of air masses to draw conclusions about the characteristics of each type of air mass. → Students will apply their understanding of the characteristics of air masses to solve riddles about weather events and the associated air masses.	Constructing Explanations and Designing Solutions Cause and Effect
36 Formative Assessment: Tornado Warning! Students will construct a model from the map found in this article (April Tornado	*Objectives:* → Students will construct an explanation based on evidence to explain the frequency of tornadoes (and severe weather) in the	Constructing Explanations and Designing Solutions Developing and Using Models

Touchdowns In The United States) to explain the formation of tornadoes in the southern/midwestern states in the spring. They should include evidence from previous activities, data, etc. in their explanation. (Student models should include notations that address the characteristics of colliding air masses, what happens when air masses collide, and how it leads to the formation of tornadoes.) This activity should be used to identify current student understanding, discuss the many variables at play when it comes to weather, and practice model-building and the incorporation/synthesis of data and previous learning. Suggested Resources: Tornadoes In April National Geographic: Birth Of A Tornado Tornadoes of 2016 SPC Tornadoes By State By Month	spring in the southern/midwestern states.	Cause and Effect
37 Weather Mystery: Case Of The Desert Tornado Students apply their understanding of weather, air masses, thunderstorms and tornadoes to evaluate clues to explain a phenomenon (a severe storm in Arizona in 2019). Students carry out an investigation by collecting data from the clues provided and then develop and communicate an explanation of the phenomenon through a "Weather Report" presentation/video project.	*Objectives:* → Students will collect data to provide evidence to explain how the motions and complex interactions of air masses resulted in a severe weather event.	Analyzing and Interpreting Data Planning and Carrying Out Investigations Constructing Explanations and Designing Solutions Cause and Effect

Sequence 4: Change And Stability In A Biome		
38 Formative Assessment: Wildlife On The Move > Anchor Phenomenon Review Students will return to the posters they created for the gallery walk at the beginning of the unit. With their new understanding of organisms and their resource needs, weather, and climate, students will discuss what might be causing habitat ranges to shift in the observed patterns. (Most are moving northward.) Anthropogenic climate change should be discussed as a cause of the shift, but its mechanisms (carbon emissions, global warming) is not the focus. However, see additional resources below if you would like your students to dive deeper into this topic. **Supplementary Resources:** Global Warming Webquest: NASA Climate Kids Evidence For Global Warming Webquest: NASA Global Climate Change	*Objectives:* → Students will reconsider the anchor phenomenon in light of what they have learned. → Students will draw conclusions about how changes in climate could impact the resources available to organisms, resulting in impacts to organisms growth and reproduction as well as population sizes.	Asking Questions and Defining Problems Constructing Explanations and Designing Solutions Change and Stability Cause and Effect
39 An Introduction To Biomes Students will obtain information from a workbook that introduces students to each of Earth's biomes. Students will use this background knowledge to choose a biome for their final unit project.	*Objectives:* → Students will obtain information from a text about Earth's biomes to understand the different climates and subsequently, environments on Earth.	Obtaining, Evaluating, and Communicating Information Stability and Change
40 Assessment: Organisms and Their Environments Students will complete a project that synthesizes and applies their understanding	*Objectives:* → Students will develop a model (map) to explain the weather patterns (climate) of a specific location within their chosen biome.	Developing and Using Models Obtaining, Evaluating, and Communicating Information Constructing Explanations and Designing

of unit ideas to Earth's biomes.	→ Students will use their model to explain the predicted impacts of climate change to their ecosystem. *Objectives:* → Students will synthesize information from several sources to create profiles of 3 key species in their ecosystem. → Students will identify and describe ways these organisms interact with biotic and abiotic factors in the ecosystem. → Students will apply their understanding of resource availability, weather, and climate to construct an explanation based on evidence for the predicted impacts of climate change on these species.	Solutions Stability and Change Energy and Matter