

Inv	Inv Title	Part	Part Summary	Sessions	Content	NGSS Standards Addressed	Disciplinary Core Ideas (Framework)	Crosscutting Concepts	Scientific and Engineering Practices (SP / EP)							
									Asking questions (SP) / Defining problems (EP)	Developing and using models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and comp. thinking	Constructing explanations (SP) / Designing solutions (EP)	Engaging in argument from evidence	Obtaining, evaluating, and communicating information
1	What is Weather?	1	Into the Weather Students delve into the question, What is weather? They view video segments of severe weather, and generate inquiry questions stimulated by the video and discussions. Meteorology is introduced as the science of weather.	3	<ul style="list-style-type: none"> Weather is the condition of Earth's atmosphere at a given time in a given place. Severe weather has the potential to cause death and destruction in the environment. Meteorology is the science of weather, and meteorologists are the people who study Earth's weather. 	<p>Foundational for 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.</p> <p>Foundational for MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS3.B: Natural Hazards</p> <ul style="list-style-type: none"> Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2) 	<p>Stability and Change</p> <ul style="list-style-type: none"> Stability might be disturbed either by sudden events or gradual changes that accumulate over time. 	SP			SP				SP
1	What is Weather?	2	Local Weather Students view local weather reports and determine the factors that combine to produce what we know as weather. They are introduced to a digital weather center to measure temperature, air pressure, and humidity. They use the tools to acquire daily data for their local site, and use media tools to track weather in another city.	2	<ul style="list-style-type: none"> Weather and climate are different. 	<p>Foundational for 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.</p> <p>Foundational for MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems 					SP			SP
2	Where's the Air?	1	The Air Around Us Students work with syringes and tubing to discover that air takes up space and is compressible. They tackle the question, Does air have mass? Using available classroom materials, they design a procedure that will demonstrate that air has mass.	2	<ul style="list-style-type: none"> Air is matter; it occupies space, has mass, and can be compressed. 	<p>Foundational for MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p> <p>Foundational for MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p>	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Systems and System Models</p> <ul style="list-style-type: none"> Defining the system under study-specifying its boundaries and making explicit a model of that system - provides tools for understanding and testing ideas that are applicable throughout science and engineering. 	SP	SP	SP	SP		SP		SP
2	Where's the Air?	2	Earth's Atmosphere Students study Earth's atmosphere using diagrams, photos from space, and a reading. They are introduced to the atmosphere as a mixture of gases with properties that change with altitude above Earth's surface.	3	<ul style="list-style-type: none"> The atmosphere is the layers of gases surrounding Earth. Weather happens in the troposphere, the layer of the atmosphere closest to Earth's surface. The troposphere is a mixture of nitrogen (78%), oxygen (21%), and other gases (1%), including argon, carbon dioxide, and water vapor. 	<p>Foundational for MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p>	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) 	<p>Patterns</p> <ul style="list-style-type: none"> Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them. 		SP		SP	SP			SP
3	Air Pressure and Wind	1	Air-Pressure Inquiry Students assemble pressure indicators (clear tubes in bottles filled with green water). They investigate the effect of air pressure on the system and consider how density is affected by air pressure. They view a demonstration of how changing air pressure affects a barometer.	2	<ul style="list-style-type: none"> Pressure exerted on a gas reduces its volume and increases its density. 	<p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p> <p>Foundational for MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p>	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. 	SP	SP		SP	SP	SP		SP

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3	Air Pressure and Wind	2	Pressure Maps Students are introduced to pressure maps and isobars as a means for representing air pressure over a large region. They locate high- and low-pressure areas on maps and predict where winds will blow and in what direction. What students predict does not exactly match what occurs because of other factors, which are introduced in a later investigation to clear up the mystery.	2	<ul style="list-style-type: none"> Wind is a large-scale movement of air. Air tends to move from regions of high pressure to regions of low pressure. Air pressure is represented on a map by contour lines called isobars. 	MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. 	SP	SP		SP	SP	SP		SP
4	Convection	1	Density of Fluids Students investigate density of fluids by layering colored salt solutions in a straw. They determine the relative densities of the salt solutions by comparing the masses of equal volumes. They calculate the density of each solution, using the ratio of mass to volume.	3	<ul style="list-style-type: none"> Density is the ratio of a mass to its volume. If two fluids have equal volumes but differ in mass, the one with the greater mass is more dense. 	Foundational for 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.	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) <p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. 	SP	SP	SP	SP	SP	SP		SP
4	Convection	2	Convection in Water Students are introduced to convection in liquids as a mechanism for energy transfer. They observe the interaction of colored water of different temperatures to determine that warm water rises and cold water descends	2	<ul style="list-style-type: none"> As matter heats up, it expands, causing the matter to become less dense. Convection is the circulation of fluid (liquid or gas) that results from energy transfer; relatively warm masses rise and relatively cool masses sink. 	<p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p> <p>Foundational for 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.</p> <p>MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.</p>	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) <p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. <p>Energy and Matter</p> <ul style="list-style-type: none"> The transfer of energy can be tracked as energy flows through a designed or natural system. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 	SP	SP	SP	SP	SP	SP		SP

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4	Convection	3	Convection in Air Students observe a model convection chamber to confirm that convection cells operate in air. The observations are extrapolated to the real world, where warm air masses move upward and cool air masses sink.	3	<ul style="list-style-type: none"> Convection is the circulation of fluid (liquid or gas) that results from energy transfer; relatively warm masses rise and relatively cool masses sink. 	<p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p> <p>Foundational for 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.</p>	<p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions - such as inputs, processes and outputs - and energy, matter, and information flows within systems. <p>Energy and Matter</p> <ul style="list-style-type: none"> The transfer of energy can be tracked as energy flows through a designed or natural system. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 	SP	SP		SP			SP	
5	Heat Transfer	1	Latitude Students examine weather data from two groups of cities to compare cities at different latitudes where other variables have been controlled. They make a greater distinction between weather and climate, then draw conclusions about the effect of latitude on climate.	2	<ul style="list-style-type: none"> Latitude is a factor that affects local weather and climate. 	<p>Foundational for 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.</p>	<p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. 	SP			SP	SP	SP		SP
5	Heat Transfer	2	Solar Angle Light is introduced as a form of energy. Students observe a demonstration of solar angle that uses a flashlight shining on surfaces at various angles and a beam of light shining on a globe. They compare the effect of a beam of light when it falls on surfaces at different angles and determine that the greater the solar angle, the greater the energy transfer.	2	<ul style="list-style-type: none"> The angle at which light from the Sun strikes the surface of Earth is the solar angle. The lower the solar angle is, the less intense the light is on Earth's surface. The Sun is the major source of energy that heats the atmosphere, and solar energy is transferred by radiation. 	<p>MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.</p> <p>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.</p>	<p>ESS1.B: Earth and the Solar System</p> <ul style="list-style-type: none"> Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause-and-effect relationships. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 	SP	SP		SP	SP	SP		SP
5	Heat Transfer	3	Heating Earth Students are introduced to energy transfer by radiation. They investigate what happens to different earth materials (sand, soil, water, air) when placed in sunshine and then in shade. They set up an experiment and collect and analyze the data. Students observe the differential heating of earth materials, one factor that contributes to weather.	3	<ul style="list-style-type: none"> The Sun is the major source of energy that heats the atmosphere, and solar energy is transferred by radiation. Heat is the increase of kinetic energy of particles. 	<p>MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.</p>	<p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) 	<p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. <p>Energy and Matter</p> <ul style="list-style-type: none"> The transfer of energy can be tracked as energy flows through a designed or natural system. 	SP	SP	SP	SP	SP	SP		SP

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6	Air Flow	1	Conduction Students observe two examples of heat transfer by conduction: movement of heat from a container of hot water to a container of cold water, and movement of heat from one end of a metal strip to the other. Students identify conduction as energy transfer between particles as a result of contact.	3	<ul style="list-style-type: none"> Energy can move from one material to another by conduction. 	<p>MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.</p> <p>MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p>	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Energy and Matter</p> <ul style="list-style-type: none"> The transfer of energy can be tracked as energy flows through a designed or natural system. 	SP	EP/SP	EP	SP		EP/SP		EP/SP
6	Air Flow	2	Local Winds Groups create diagrams that show what happens in the atmosphere to create wind. They label their diagrams to represent differential heating, energy transfer, convection, change of density, change of atmospheric pressure, and wind.	1	<ul style="list-style-type: none"> Differential heating of Earth's surface by the Sun can create high- and low-pressure areas. Local winds blow in predictable patterns determined by local differential heating. 	<p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p> <p>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p> <p>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.</p>	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) <p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause-and-effect relationships. <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. <p>Energy and Matter</p> <ul style="list-style-type: none"> Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 	SP	SP		SP		SP		SP
6	Air Flow	3	Global Winds Students revisit their wind predictions from Investigation 3, and start to explore reasons that could explain the unpredicted wind movement. They compare data to their models and determine that convection cells and the Coriolis effect are responsible for the wind patterns on Earth.	3	<ul style="list-style-type: none"> Convection cells and Earth's rotation determine prevailing winds on Earth. 	<p>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p> <p>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.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause-and-effect relationships. <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. <p>Energy and Matter</p> <ul style="list-style-type: none"> The transfer of energy can be tracked as energy flows through a designed or natural system. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 	SP	SP		SP		SP		SP

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7	Water in the Air	1	Is Water Really There? Students are challenged to come up with investigations to show that water vapor is in the air around them. Materials are provided, and each group plans an investigation, conducts it, and reports to the class in a short presentation	2	<ul style="list-style-type: none"> Water changes from gas to liquid by condensation. 	<p>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.</p> <p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) <p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause and effect relationships. <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. 	SP	SP	SP	SP		SP	SP	
7	Water in the Air	2	Phase Change and Energy Transfer Students experience a temperature change as water evaporates, and ponder the energy transfers involved as water changes from liquid to gas. Humidity is introduced as the measure of water vapor in the air, and students consider dew point.	2	<ul style="list-style-type: none"> Water changes from liquid to gas (vapor) by evaporation. Temperature change, which is evidence of energy transfer, accompanies evaporation. Dew point is the temperature at which air is saturated with water vapor and vapor condenses into liquid. 	<p>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.</p> <p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (secondary to MS-PS1-4) <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause-and-effect relationships. <p>Energy and Matter</p> <ul style="list-style-type: none"> Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 	SP	SP				SP		SP
7	Water in the Air	3	Clouds and Precipitation Students investigate the relationship between pressure and temperature, using 2 L plastic bottles and thermometer strips. They discover that the greater the pressure in a gas, the higher the temperature. They apply this idea to air rising in the atmosphere. Air pressure drops as elevation increases, so a mass of air would expand as it ascends. As it expands, it cools. They use this understanding of pressure and temperature to explore cloud formation.	4	<ul style="list-style-type: none"> Water changes from gas to liquid by condensation. Dew point is the temperature at which air is saturated with water vapor and vapor condenses into liquid. Increasing the pressure of a given volume of air increases the temperature of air. 	<p>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.</p> <p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (secondary to MS-PS1-4) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause-and-effect relationships. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Energy and Matter</p> <ul style="list-style-type: none"> The transfer of energy can be tracked as energy flows through a designed or natural system. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 	SP	SP		SP		SP		SP

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8	Meteorology	1	Weather Balloons Students use an online simulation to analyze data collected by weather balloons launched in Phoenix, AZ, and Chicago, IL. They analyze charts of data collected by weather balloons launched in four cities.	1	<ul style="list-style-type: none"> Weather balloons travel high in the atmosphere and collect physical data using a radiosonde. Data from weather-balloon radiosondes can be used to determine dew point and the likelihood of clouds forming. 	MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) 	<p>Patterns</p> <ul style="list-style-type: none"> Graphs, charts, and images can be used to identify patterns in data. <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. 	SP			SP	SP	SP		SP
8	Meteorology	2	Weather Maps Students consider all the factors that cause weather, and apply their knowledge to interpret a weather map. After learning about fronts, they pull together data about temperature, precipitation, surface wind, air pressure, and fronts to give a weather report for a given location.	4	<ul style="list-style-type: none"> Weather maps combine many kinds of atmospheric and surface data, including pressure, temperature, wind direction, wind speed, and precipitation. Fronts are areas where large air masses collide. 	<p>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p> <p>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.</p> <p>MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) <p>ESS3.B: Natural Hazards Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)</p>	<p>Patterns</p> <ul style="list-style-type: none"> Graphs, charts, and images can be used to identify patterns in data. <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. <p>Energy and Matter</p> <ul style="list-style-type: none"> Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. 	SP	SP		SP	SP	SP	SP	SP
9	The Water Planet	1	Water-Cycle Simulation Students consider why Earth is called the water planet. They observe a demonstration that shows how Earth's water is distributed. They participate in a simulation of the travels of a water particle through the water cycle. They compare the results of the simulation to their understanding of how the water cycle operates on Earth. After exploring an online version of the simulation, students use what they learned to diagram the water cycle and consider the implications of human water use and human population growth.	2	<ul style="list-style-type: none"> Most of Earth's water is saltwater in the ocean, and Earth's fresh water is found in many locations. A water particle might follow many different paths as it travels through the water cycle. 	<p>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</p> <p>MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) <p>ESS3.A: Natural Resources</p> <ul style="list-style-type: none"> Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1) <p>ESS3.C: Human Impacts on Earth's Systems.</p> <ul style="list-style-type: none"> Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause and effect relationships. Graphs, charts, and images can be used to identify patterns in data. <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. <p>Energy and Matter</p> <ul style="list-style-type: none"> Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. <p>Stability and Change</p> <ul style="list-style-type: none"> Stability might be disturbed either by sudden events or gradual changes that accumulate over time. 	SP	SP		SP	SP	SP		SP

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9	The Water Planet	2	Ocean Currents Students predict patterns of ocean currents, based on their experience with global winds, then explore actual patterns and causes of ocean currents.	1	<ul style="list-style-type: none"> Ocean currents are caused primarily by winds, convection of ocean water, and the Coriolis effect. 	<p>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.</p> <p>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.</p>	<p>ESS2.C The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) <p>ESS2.D: Weather and Climate.</p> <ul style="list-style-type: none"> The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography all of which can affect oceanic, and atmospheric flow patterns. (MS-ESS2-6) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause and effect relationships. Graphs, charts, and images can be used to identify patterns in data. <p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. <p>Systems and system models</p> <p>Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.</p> <p>Energy and Matter</p> <ul style="list-style-type: none"> Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. <p>Stability and Change</p> <ul style="list-style-type: none"> Stability might be disturbed either by sudden events or gradual changes that accumulate over time. 	SP	SP		SP			SP	
9	The Water Planet	3	Ocean Climate Students review climate data for pairs of cities and determine what effect distance from the ocean has on temperature range and average annual rainfall. They consider what properties of the ocean would cause these climate effects.	3	<ul style="list-style-type: none"> A location's proximity to a large body of water generally results in less temperature variation and more precipitation. 	<p>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</p> <p>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.</p>	<p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) 	<p>Patterns</p> <ul style="list-style-type: none"> Patterns can be used to identify cause and effect relationships. Graphs, charts, and images can be used to identify patterns in data. <p>Cause and Effect</p> <ul style="list-style-type: none"> Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. <p>Energy and Matter</p> <ul style="list-style-type: none"> Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. <p>Stability and Change</p> <ul style="list-style-type: none"> Stability might be disturbed either by sudden events or gradual changes that accumulate over time. 	SP			SP	SP	SP		SP
10	Climate over Time	1	Climate Change Students analyze climate graphs for four different geographical locations and look for changes over a 50-year period. They consider evidence of climate changes over geological time periods.	1	<ul style="list-style-type: none"> Weather is the condition of the atmosphere at a specific time and location; climate is the average weather in a region over a long period of time. Climate can change over time because of natural Earth cycles or human-induced changes. 	<p>MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</p>	<p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) <p>ESS3.D: Global Climate Change</p> <ul style="list-style-type: none"> 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) 	<p>Patterns</p> <ul style="list-style-type: none"> Graphs, charts, and images can be used to identify patterns in data. <p>Cause and Effect</p> <ul style="list-style-type: none"> Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. <p>Stability and Change</p> <ul style="list-style-type: none"> Stability might be disturbed either by sudden events or gradual changes that accumulate over time. Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale. 	SP			SP	SP	SP		SP

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10	Climate over Time	2	The Role of Carbon Dioxide Using a computer simulation, students explore the effects of carbon dioxide and other greenhouse gases in the atmosphere. They use data to build a case that an increase in greenhouse gases in Earth's atmosphere can lead to an increase in Earth's average temperature (global warming).	2	<ul style="list-style-type: none"> When greenhouse-gas concentrations in the atmosphere increase, the global temperature rises. Human activity can affect Earth's weather and climate. 	<p>MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p> <p>MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</p>	<p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) <p>ESS3.C: Human Impacts on Earth Systems</p> <ul style="list-style-type: none"> Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the technologies involved are engineered otherwise. (MS-ESS3-3), (MS-ESS3-4) <p>ESS3.D: Global Climate Change</p> <ul style="list-style-type: none"> 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) 	<p>Patterns</p> <ul style="list-style-type: none"> Graphs, charts, and images can be used to identify patterns in data. <p>Cause and Effect</p> <ul style="list-style-type: none"> Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. <p>Stability and Change</p> <ul style="list-style-type: none"> Stability might be disturbed either by sudden events or gradual changes that accumulate over time. 	SP	SP		SP	SP	SP		SP
10	Climate over Time	3	Climate in the News Students read summaries of news stories from the past decade, looking for evidence of climate change and whether that change is caused by humans.	1	<ul style="list-style-type: none"> Human activity can affect Earth's weather and climate. 	<p>MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p> <p>MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</p>	<p>ESS3.A: Natural Resources</p> <ul style="list-style-type: none"> Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1) <p>ESS3.C: Human Impacts on Earth Systems</p> <ul style="list-style-type: none"> Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the technologies involved are engineered otherwise. (MS-ESS3-3), (MS-ESS3-4) <p>ESS3.D: Global Climate Change</p> <ul style="list-style-type: none"> 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 knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5) 	<p>Patterns</p> <ul style="list-style-type: none"> Graphs, charts, and images can be used to identify patterns in data. Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. <p>Cause and Effect</p> <ul style="list-style-type: none"> Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> The observed function of natural and designed systems may change with scale. <p>Stability and Change</p> <ul style="list-style-type: none"> Stability might be disturbed either by sudden events or gradual changes that accumulate over time. Small changes in one part of a system might cause 	SP			SP	SP	EP/SP	SP	SP

Inv	Inv Title	Part	Part Summary	Sessions	Content	NGSS Standards Addressed	Disciplinary Core Ideas (Framework)	Crosscutting Concepts	Asking questions (SP) / Defining problems (EP)	Developing and using models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and comp. thinking	Constructing explanations (SP) / Designing solutions (EP)	Engaging in argument from evidence	Obtaining, evaluating, and communicating information
10	Climate over Time	4	Identify Key Ideas Students look back on the entire Weather and Water Course to review the Weather and Water big ideas they've recorded along the way, and in particular to review the distinction between weather and climate.	2	<ul style="list-style-type: none"> Weather is the condition of the atmosphere at a specific time and location; climate is the average weather in a region over a long period of time. Climate can change over time because of natural Earth cycles or human-induced changes. 	<p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p> <p>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.</p> <p>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p> <p>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.</p> <p>MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</p>	<p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) <p>ESS2.C: The Roles of Water in Earth's Surface Processes</p> <ul style="list-style-type: none"> 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) <p>ESS2.D: Weather and Climate</p> <ul style="list-style-type: none"> Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6) The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6) <p>ESS3.C: Human Impacts on Earth Systems</p> <ul style="list-style-type: none"> Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4) 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p>Systems and System Models</p> <ul style="list-style-type: none"> Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. <p>Stability and Change</p> <ul style="list-style-type: none"> Stability might be disturbed either by sudden events or gradual changes that accumulate over time. 	SP			SP		SP	SP	SP