Title	**Roxbury High School Meteorology**
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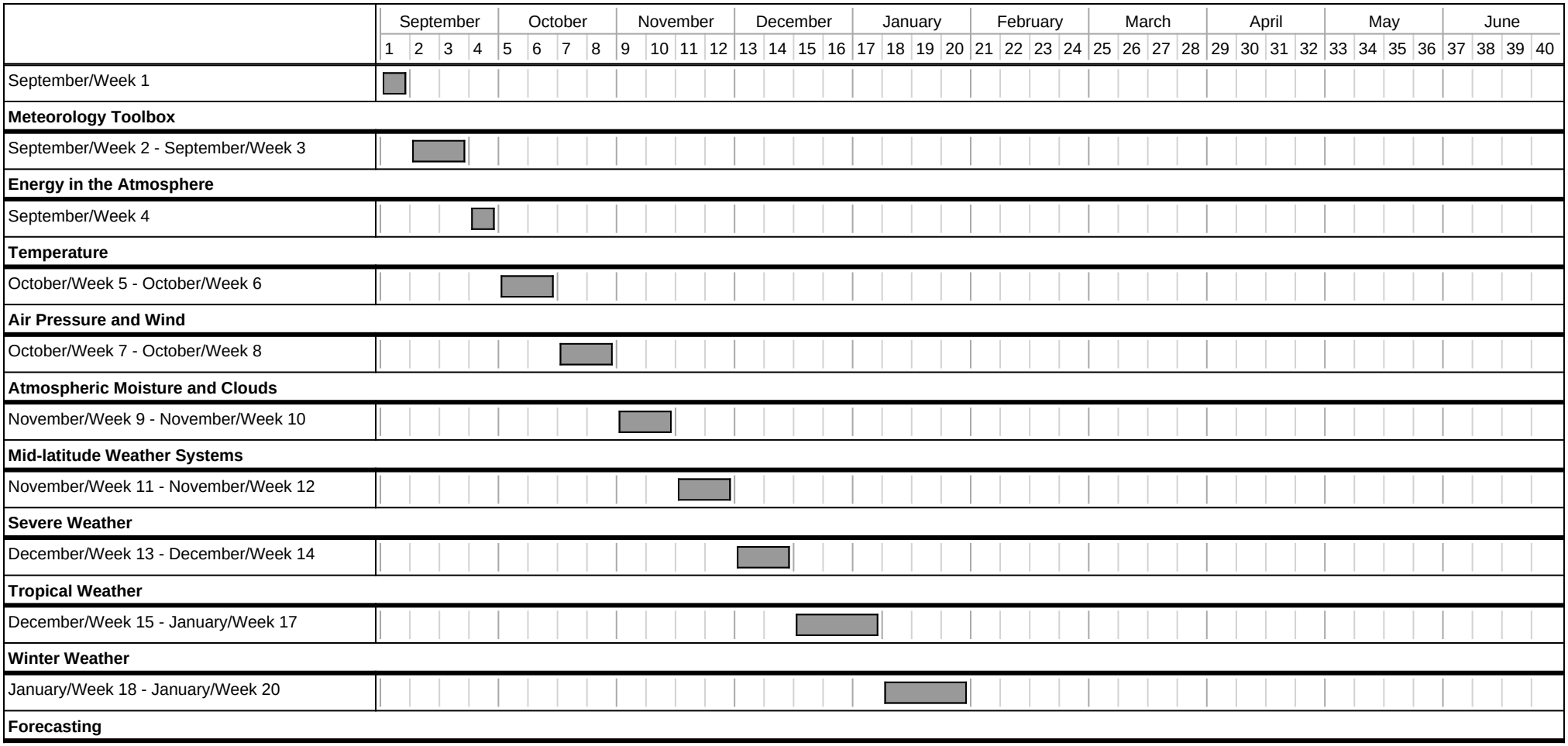
Authors	Denise Glenn, Chris Blough
Subject	Science
Course	-SCIENCE-
Grade(s)	11 , 12
Location	Roxbury High School
Curriculum Writing History	
Notes	
Attachments	

Title : Roxbury High School Meteorology
Type : Consensus



Title : Roxbury High School Meteorology
Type : Consensus

Duration: September/Week 1					
UNIT NAME: Meteorology Toolbox					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	What are the common units of measure for temperature, pressure, and time used in meteorology? How can meteorological variables be represented on a map? How can meteorological variables be represented on a graph? What is the latitude/ longitude system and how is it used? What are some meteorological terms to know when describing the weather?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. Line and bar graphs can be used to see trends in various weather variables. Contours can be used to indicate lines of equal height, temperature, pressure, dew point, etc. Temperature can be	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth. Create line and bar graphs using meteorological data. Construct contour maps using a variety of meteorological variables. Convert EST or EDT into universal time (Z).		HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.3-The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy 's re-radiation into space. (HS-ESS2-4), (secondary to HS-ESS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.4-Changes in the

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		measured in Fahrenheit or Celsius. Pressure is measured in inches of mercury or millibars. Time is synchronized world-wide to make observations at the same time everywhere. The latitude/longitude system divides Earth into hemispheres and degrees to give specific locations.	Locate various places using the latitude/longitude system. World of Weather - 1		atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.1-Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.2-New technologies advance scientific knowledge. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.3-Science knowledge is based on empirical evidence. (HS-ESS3-5) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.4-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)]

					HS.ESS3.5.CCC.1-Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Duration: September/Week 2 - September/Week 3					
UNIT NAME: Energy in the Atmosphere					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	How does energy flow into and out of the Earth-atmosphere system to maintain a habitable planet? How does energy get transferred within Earth's atmosphere locally? Globally? What is the greenhouse effect? Is it helpful? Harmful? Both?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. The specific heat of a material is how much energy is required to raise the temperature of that material 1 C. Latent heat is the heat required to change the state of a substance, namely water.	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth. Predict the general radiation budget for a given location on earth and determine if climate change is altering the yearly energy budget for that location. Differentiate between the albedoes of various		HS.ESS2.5.DCI.ESS2.C.1-The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy , transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.6.SEP.1-Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-3),(HS-ESS2-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.6.CCC.1-The total amount of energy and matter in closed systems is conserved. (HSESS2-6) (09-12)

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		Heat can be transferred though the atmosphere by conduction, convection, and/or radiation. Incoming solar radiation changes throughout year at a given latitude. The greenhouse effect warms the surface of the Earth to keep it at a habitable temperature. Enhancing the greenhouse effect with extra greenhouse gases warms the earth's surface as a whole, on average. Earth's energy budget takes into account radiation absorbed and reflected by Earth's surface, atmosphere, and clouds. The extra radiation gained at the equator is transferred to the radiation depleted poles through atmosphere and oceanic circulations.	surfaces and their contribution to climate change. Explain how human-driven climate change is occurring now and what it may lead to in the future for various locations on Earth. Meteorology Today - 2		[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.7.SEP.1-Construct an oral and written argument or counterarguments based on data and evidence. (HS-ESS2-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.7.CCC.1-Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS2-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.SEP.1-Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.2-New technologies advance scientific knowledge. (HS-

					ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CCC.1-Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS3.D.2-Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Title : Roxbury High School Meteorology
Type : Consensus

Duration: September/Week 4					
UNIT NAME: Temperature					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	How is surface temperature properly measured? What environmental factors influence daily and yearly temperature changes at a given location?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. Surface temperature is taken 1.5m above the gound, in the shade. Changing elevation effects temperature. The changing sun angle throughout the year effects temperature at the surface.	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth. Convert between Fahrenheit and Celsius. Explain that, typically, temperature decreases with height in the troposphere so elevation changes between locations can have large temperature differences.		HS.ESS2.2-Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.2.DCI.ESS2.D.2-The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy 's re-radiation into space. (HS-ESS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.6.CCC.1-The total amount of energy and matter in closed systems is conserved. (HSESS2-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.7-Construct an argument based on evidence about the simultaneous co-evolution

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		Cloud cover effects surface heating and radiational cooling at night. A location's temperature is controlled by it's relation to latitude, closeness of land to water, ocean currents, and elevation.	Describe the effect of bodies of water and ocean currents have on regulating the temperature of locations near them. Analyze daily temperature changes at a location based on it being clear or cloudy. World of Weather - 3		of Earth systems and life on Earth. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.7.SEP.1-Construct an oral and written argument or counterarguments based on data and evidence. (HS-ESS2-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.SEP.1-Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.4-Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)]

					HS.ESS2.4.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.4-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS2.D.1-Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards

					(NGSS)] HS.ESS3.6.DCI.ESS3.D.2-Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Duration: October/Week 5 - October/Week 6					
UNIT NAME: Air Pressure and Wind					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	What is air pressure and how is it measured? How can air pressure change? How are pressure maps constructed? What can these horizontal pressure differences indicate about the weather? What forces govern the direction and speed of the wind? How are 500mb upper-air maps generated and how are they used to show atmospheric motion? How does air generally circulate around Earth? What permanent or semi-permanent features are created by the general atmospheric circulation?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Air pressure is the weight of the column of air above a given location. Air pressure depends on the temperature and, therefore, density of the given parcel of air. Air pressure decreases with height, and is normalized for locations at elevation to create surface pressure maps. Wind directions and relative speeds can be analyzed from surface pressure maps. Surface pressure maps show the locations of high and low pressure systems, and indicate the flow of air around them.	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Describe how pressure changes with height in the atmosphere. Explain how surface pressure maps are made in regards to normalizing locations to sea surface. Construct and evaluate surface pressure maps. Evaluate upper-air maps. Describe and construct models of global air circulation. Indicate the climate that persists in certain areas of the world based on the general global circulation.		HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.SEP.1-Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.3-The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy 's re-radiation into

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		The atmosphere carries heat from the equator to the poles. In that transport, features like the ITCZ, monsoons, subtropical highs, trade winds, and jet streams form.	World of Weather - 4, 7		space. (HS-ESS2-4), (secondary to HS-ESS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.4-Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5-Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.SEP.1-Analyze data using

					computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.2-New technologies advance scientific knowledge. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.4-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CCC.1-Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.1.SEP.1-Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models,

					theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.1.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.2.CNS.1-Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.2.CNS.3-Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)]

					HS.ESS3.3.CCC.1-Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.3.CET.2-New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Duration: October/Week 7 - October/Week 8					
UNIT NAME: Atmospheric Moisture and Clouds					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	How does water move throughout the atmosphere? What can specific and relative humidity tell you about the current weather conditions? How does relative humidity change during a typical day? Why? When does dew or frost form? How is relative humidity measured manually? In what ways can fog form? What are the general types of clouds? How is the stability of the atmosphere found and what does it have to do with cloud development? How and where do clouds form?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Water exists in each state in the atmosphere, constantly changing between all three. Warmer air can hold more water vapor that colder air. Specific humidity measures how much water vapor by mass there is in the air compared to how much total mass of air there is in a given parcel. Relative humidity measures how much water vapor there is in the air compared to how much water vapor that air can hold. Dew and frost points can be calculated using saturation points of given	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Describe the changes in state of water in the atmosphere and the latent heat transferred in all cases. Explain what specific and relative humidity are. Calculate dew and frost points given temperature and humidity observations. Analyze humidity and temperature charts to determine heat index. Use a sling psychrometer to measure the wet-bulb temperature, dew point, and humidity inside and outside. Determine the stability of the atmosphere.		HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.SEP.1-Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.3-The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy 's re-radiation into

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		air parcels. Dew points and wet-bulb temperatures are used to calculate heat index. Humidity can be measured manually using sling psychrometers. Radiative and advective fog can form in certain conditions to cover areas for long periods of time. Steam fog is an example of mixing fog that occurs over lakes or cold oceans. Clouds form at different levels of the atmosphere and are named based on their height and shape. Satellites can see clouds using their visible setting or can 'see' the water vapor in the air using infrared setting. As air rises it cools off. Dry air cools faster than moist air as it rises. As air sinks, it warms and dries out. Clouds will form once a rising air parcel reaches it's dew point and will continue to build in height until the air is not	Determine at what height clouds will form in the atmosphere. Meteorology Today - 4-6		space. (HS-ESS2-4), (secondary to HS-ESS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.SEP.1-Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.2-New technologies advance scientific knowledge. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.3-Science knowledge is based on empirical evidence. (HS-ESS3-5) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CCC.1-Change and rates of change can be quantified

		saturated.			and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.1-Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.1.SEP.1-Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.1.CET.1-Modern civilization depends on major technological systems.

					(HS-ESS3-1),(HSESS3-3) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.2-Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.2.SEP.1-Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relev ant factors (e.g. economic, societal, environmental, ethical considerations). (HS-ESS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.2.DCI.ESS3.A.1-All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2) (09-12)

					[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.3.CCC.1-Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.3.CET.2-New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.SEP.1-Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and

					described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Duration: November/Week 9 - November/Week 10					
UNIT NAME: Mid-latitude Weather Systems					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	What are the characteristics of various air masses? How and where do they form? What happens when two air masses combine? What types of fronts can develop in a mid-latitude cyclone? How does the upper-air flow near a surface cyclone support or inhibit the growth of the cyclone?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Air masses are large pools of air with essentially the same characteristics. They form over large source regions around Earth. Weather fronts are formed on the boundary different air masses. Fronts tend to be found in troughs of low pressure and winds converge, creating clouds and precipitation. There are four types of fronts that can form, cold, warm, stationary, and occluded. Cyclogenesis is the process of creating a large, mid-latitude frontal	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Locate and describe the locations of air mass generation. Explain the various types of fronts that can form when air masses meet and the weather associated with them. Describe how cyclogenesis occurs and the necessary upper-air features that should be present for supporting a mature mid-latitude cyclone. Meteorology Today - 11, 12 World of Weather - 8		HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.SEP.1-Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.3-The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy 's re-radiation into

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		system (cyclone). Vorticity is the spin in the atmosphere. It can be at a minimum at the top of a ridge and a maximum at the bottom of a trough. Upper-air convergence or divergence lining up with surface features is necessary for cyclone development.			space. (HS-ESS2-4), (secondary to HS-ESS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.4-Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5-Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.SEP.1-Analyze data using

					computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.2-New technologies advance scientific knowledge. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.SEP.1-Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS3.D.2-Through computer simulations and other studies, important discoveries are still being

					made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) (09-12)[Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Duration: November/Week 11 - November/Week 12					
UNIT NAME: Severe Weather					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	What conditions are needed for thunderstorms to develop? What features can thunderstorms create? How do supercell thunderstorms form and why do they produce tornadoes? How is lightning produced by thunderstorms and how does it discharge to the ground? How is hail produced by thunderstorms? Why can it grow to damaging sizes? Where and how to tornadoes develop within supercell thunderstorms? How can tornadic activity be predicted or followed during the events? What safety measures should be followed if a tornado warning is issued?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Cell thunderstorms develop where there is instability and little wind shear. Severe thunderstorms produce high winds, heavy rain, lightning, hail, and/or tornadoes. A supercell thunderstorm rotates within the wind shear environment and produce tornadoes at higher rates than normal severe storms. Squall lines and Mesoscale Convective Complexes can produce thunderstorm activity over a wide area. Thunderstorms can produce microbursts, roll	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Explain the life cycle of a cellular thunderstorm. Describe the conditions that are produced by severe thunderstorms. Describe various features that can be produced by thunderstorms, such as shelf clouds, roll clouds, mammatus clouds, microbursts, and outflow boundaries. Explain how hail is formed inside a severe thunderstorm and how it can grow to be large. Explain how lightning is formed inside a thunderstorm and how a bolt of lightning is discharged to the ground.		HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.3-The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy 's re-radiation into space. (HS-ESS2-4), (secondary to HS-ESS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.4-Changes in the

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		clouds, and shelf clouds. Lightning is produced inside thunderstorm clouds from the separation of charge within the cloud. Tornadoes develop within some supercell thunderstorms. Many tornadoes can occur within the same weather system if conditions are right, leading to an outbreak. Large tornadoes can have suction vortices within their structure, creating even faster winds and more damage. Tornado watches and warnings are posted by the Storm Prediction Center to warn the public about potential tornadic conditions. The Enhanced Fujita scale rates tornadoes based on the damage they produce and equating that damage to a wind speed range. Radar can be used to see storm structure and see rotation within thunderstorms.	Describe the formation of a tornado within a supercell thunderstorm. Evaluate tornadoes based on the Enhanced Fujita Scale. Locate and evaluate areas of potential severe weather on a given weather map. Locate and evaluate areas of potential tornadic activity on a given radar loop. Explain the proper safety protocols for various situations during tornadic events. World of Weather - 9, 10 Meteorology Today - 14		atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.SEP.1-Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.1-Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.3-Science knowledge is based on empirical evidence. (HS-ESS3-5)

					(09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS3.D.2-Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Duration: December/Week 13 - December/Week 14					
UNIT NAME: Tropical Weather					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	Where on Earth can tropical systems form? What conditions are needed for tropical system development? What is the life cycle of a mature hurricane/typhoon/ cyclone? What features are associated with strong tropical systems? How are tropical systems rated? Who tracks, forecasts, and warns the public about potentially dangerous storms? What are the various dangers associated with landfalling tropical systems? How are current tropical systems evaluated, tracked, and forecast?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. Tropical systems need specific environments to be created. Namely, sufficiently warm and deep water, and calm surface and upper-air motion. Tropical systems grow from tropical waves, into tropical depressions, to	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth. Evaluate current conditions in areas prone to tropical development. Explain the life cycle of a hurricane. Describe the hazards associated with landfalling tropical systems.		HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.SEP.1-Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)]

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		tropical storms, and finally hurricanes (or typhoons/ cyclones). Clear eyes can form in large, well developed hurricanes. The worst weather is within the eyewall of the system, although destructive winds, rain, and tornadoes can form away from the center. The Saffir-Simpson Scale is used to rate hurricane intensity based on the wind speed in the eyewall from Category 1 to 5. Storm surge is the most destructive aspect of a landfalling tropical system. The tracks that tropical systems can take are dependent on the steering winds and other weather features near the ongoing system. The National Hurricane Center tracks, forecasts, and posts watches/ warnings for tropical systems that may effect the United States. Hurricane Hunters are aircraft that fly into tropical systems to collect current	Use the Saffir-Simpson Scale to evaluate past tropical systems. Evaluate satellite and radar images/loops to describe the current state of a tropical system. Track a given historical storm and explain reasons for it going where it ultimately did. World of Weather - 11 Meteorology Today - 15		HS.ESS3.5.SEP.1- Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.1- Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.3- Science knowledge is based on empirical evidence. (HS-ESS3-5) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.4- Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS2.D.1- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue

		data that will be used for forecast purposes as well. Important information on the system's movement, strength, and life cycle can be seen on radar and satellite images/loops.			to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Duration: December/Week 15 - January/Week 17					
UNIT NAME: Winter Weather					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	How do ice crystals form in the atmosphere? What can happen to them as they fall to the surface? Why is it more difficult to forecast winter storms then storms other times of the year? How and where do winter storms form? What ingredients or set-ups are looked for when forecasting winter storm development? What causes winter storms to move in certain directions or along certain tracks? What is a Nor'easter and what is there significance to US winter weather? How is lake effect snow formed? What locations receive the most snowfall and at what times of the year? What are the hazards associated with winter weather?	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. There are various types of ice crystals that can form. Winter precipitation depends on surface and upper-air temperatures. Various types of precipitation can form within the same winter	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth. Describe the formation of ice crystals and how they can change in the atmosphere. Explain the types of winter precipitation that can fall in a given storm. Evaluate surface and		HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.SEP.1-Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.A.2-The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers,

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.		storm. Predicting types of precipitation and snowfall totals is extremely difficult near 'warm' ocean water. A storm's development and track are dependent on jet stream location and motion. There are many tracks that traditional Northeastern winter storms can take. Jet streaks are associated with upper-air divergence and therefore surface cyclogenesis. Nor'easters are major coastal storms that effect the eastern seaboard. Cold-air damming occurs when cold air is forced up against a mountain range by high pressure. Warm, moist air could overrun this area producing winter storms. Lake effect snow is produced by cold air moving over a 'warm' open lake. This causes lake water to evaporate and make the air unstable, causing clouds and snowfall to form.	upper-air maps for areas of potential winter storm development. Describe the formation and evolution of a Nor'easter. Explain the process of lake-effect snow production. Describe the hazards of winter exposure to the human body as well as travel and building hazards. World of Weather - 12		vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.3-The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy 's re-radiation into space. (HS-ESS2-4), (secondary to HS-ESS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.DCI.ESS2.D.4-Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CCC.1-Empirical evidence is required to differentiate between cause and

		Wind chill is the apparent temperature felt when wind speed is combined with cold temperatures. There are many hazards associated with winter weather including frostbite, hypothermia, and driving/ building condition issues.			correlation and make claims about specific causes and effects. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.1- Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.3- Science knowledge is based on empirical evidence. (HS-ESS3-5) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS2.D.1- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) (09-12)

					[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS3.D.2-Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Meteorology
Type : Consensus

Duration: January/Week 18 - January/Week 20					
UNIT NAME: Forecasting					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use a model to provide mechanistic accounts of phenomena. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. Analyze data using computational models in order to make valid and reliable scientific claims. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. Science knowledge is based on empirical evidence. Science arguments are	How does the National Oceanic and Atmospheric Association (NOAA) issue various watches and warnings? What are the various computer models available to meteorologists? How often do they output information? How is the model forecast used by the meteorologist to create a forecast? What benchmarks can be looked at when determining a forecast? How is current and past meteorological data acquired? What time frames can forecasts be made for? What is the confidence within each time frame? What are the various teleconnections that can be present which could affect the weather of the United States? How can a short range forecast be made just by	The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. There are a variety of watches and warnings that can be posted by different divisions of the National Oceanic and Atmospheric Association (NOAA). Many types of computer models output forecasts at certain times of the day. Meteorologists use the model outputs as guidance when preparing a final forecast. There are various 'rules of thumb' to use when forecasting the weather. Meteograms are produced by weather stations that show past weather data at that location.	Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. Describe the watches and warnings that can be posted for various types of severe weather. Explain the types of weather models available and how they are used by meteorologists. Evaluate current weather conditions by making real-time observations to make a short-range local forecast. Describe how meteorological data is collected and used to make short and long-range forecasts. Explain the various teleconnections and how they affect weather and		HS.ESS2.6.DCI.ESS2.D.2-Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4-Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.SEP.1-Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CNS.1-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)]

strengthened by multiple lines of evidence supporting a single explanation. Empirical evidence is needed to identify patterns. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.	looking outside at current conditions? How do meteorologists forecast where weather systems will go?	Weather balloon soundings are used to capture weather data from the surface to the top of the atmosphere. They are released at the same time at every location twice a day. There are various types of forecasts ranging from seasonal forecasts to very short-range forecasts. Teleconnections like El Nino and La Nina are looked at intensively when trying to figure out seasonal forecasts and may influence short to long range forecasts. Short range forecasts can be made from simple ground observations. The movement of weather systems can be forecast by looking at surface and upper-air charts.	climate in different regions of the world. Evaluate current surface and upper-air maps to forecast the direction or formation of weather systems. Meteorology Today - 13		HS.ESS2.4.DCI.ESS2.D.4-Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS2.4.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5-Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.SEP.1-Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) (09-12) [Regional:Next Generation

					Science Standards (NGSS)] HS.ESS3.5.CNS.2-New technologies advance scientific knowledge. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CNS.4-Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4), (HSESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.5.CCC.1-Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.1.SEP.1-Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate

					today as they did in the past and will continue to do so in the future. (HS-ESS3-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.2.SEP.1-Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relev ant factors (e.g. economic, societal, environmental, ethical considerations). (HS-ESS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.3.CET.2-New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS2.D.1-Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend

					on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.DCI.ESS3.D.2-Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS3.6.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					