	Course Title: Meteorology **Course Description:** Weather and Climate is the scientific study of atmospheric processes and patterns, and their impact on human activities. Weather and Climate examines the collection and analysis of meteorological data at local, regional, and global scales. Topics include the heat, moisture, and wind dynamics of the atmosphere, application of satellite and radar data, development and impact of thunderstorms, tornadoes and hurricanes, weather analysis and forecasting, and the study of climate and climate change. **Length of Course (semester long, or year-long)**	
Essential Questions	*How do meteorologists study the atmosphere?* *What is the atmosphere? What is it made of?* *What does the atmosphere do for me?*	
Unit One: The Atmosphere Layers of the atmosphere **Standards**	Functions: Interpreting Functions F-IFMA.8.c. Translate among different representations of functions and relations: graphs, equations, point sets, and tables. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: **a.** An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles. **b.** An angle that turns through n one-degree angles is said to have an angle measure of n degrees. 6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure. **1.5** Explain how the revolution of Earth around the Sun and the inclination of Earth on its axis cause Earth's seasonal variations (equinoxes and solstices).	
Concepts and Skills	• Students will study how earth-sun geometry influences such phenomena as the seasons and the amount of daylight we receive.	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **CCR Reading Standards** CCRSL.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCRSL.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. **CCR Writing Standards** CCWSL.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **CCR Math Standards** CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size

		to gauge the variation in estimates or predictions. CCSS.Math.Content.7.SP.C.6 approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. CCSS.Math.Content.8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. CCSS.Math.Content.8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
Content Objectives	The atmosphere is the envelope of gases surrounding the earth. Students will: • Learn that the atmosphere is comprised of five layers, the physical composition of each layer, and their relationship to one another. • Weather occurs in the lowest part of the atmosphere called the troposphere. • Air pressure is the weight of the air on top of us. • Air pressure is high when molecules in the air are tightly packed together and low when • Molecules in the air have plenty of space. • Air pressure decreases with height.	
Assessments/ Products	Students will be assessed based on their laboratory work, quizzes, tests, individual and group assessments and a culminating performance task. **Labs/Demos/Projects:** o Changes in Atmospheric Pressure with Height o Zenith and solar elevation angles. o Measuring Solar Elevation Angle (Sun Angle) o Calculating Solar Intensity **Notebooks:** **Content Notes** (every day or close to it): Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). **Vocabulary:** Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development	

	exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. **Narrative and Explanatory Essay** (in response to one or more Essential and Guiding Questions)/Investigation Reports: Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
Texts, Materials, and Resources	• Youtube (Coriolis Effect, Global Winds, ocean currents, space weather, layers of the atmosphere, land vs. sea breezes, etc.) • Climate Science Resources (University of Massachusetts, Lowell) • Exercises for Weather and Climate • Earth Networks weather system • Earth Networks "Achieve" standards based lessons • Science Daily Meteorology
	Course Title **Course Description** **Length of Course (semester long, or year-long)**
Essential Questions	*What technologies do we use to study and forecast the weather?* *What role does the sun play in our weather?*
Unit Two: The Earth's Weather Uneven heating of the Earth's atmosphere Coriolis influence on global circulation patterns Global winds Convection cells Land vs. Sea Breezes, Mountain vs	**1.3** Explain how the transfer of energy through radiation, conduction, and convection contributes to global atmospheric processes, such as storms, winds, and currents. **3.1** Explain how heat energy is transferred by convection, conduction, and radiation

Valley Breezes **Standards**		
Concepts and Skills	Students are introduced to radiation laws and the fluxes of radiation and other energy forms at the earth's surface. Students will study how seasonal, diurnal, and meteorological factors influence these energy exchanges Students learn that the radiation budget is comprised of four fluxes: Two incoming waves, one long term and one short term, as well as two outgoing waves, one long term and one short term. Incoming radiation measured at the Earth's surface. Outgoing radiation emitted by the atmosphere. With 70% Earth's surface covered by water, students study how this influences the planet's temperature.	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **CCR Reading Standards** CCRSL.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCRSL.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. **CCR Writing Standards** CCWSL.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **CCR Math Standards** CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. CCSS.Math.Content.7.SP.C.6 approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. CCSS.Math.Content.8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. CCSS.Math.Content.8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
Content Objectives	The Earth's weather is the state of the atmosphere at a given time and place. Students will learn that: • Weather processes such as *wind*, *clouds,* and *precipitation* are the result of the uneven heating of the Earth by the Sun. •The Coriolis Effect is the apparent curvature of global winds, ocean currents and anything that moves freely across the Earth's surface. • The global winds are the winds that blow across the entire surface of the Earth, and that they are known by different names depending on the origin of the direction from which they originate. • Convection cells are a means for the transfer of energy across the Earth's surface and that they result due to the Earth's differential heating.	

	• Land breezes are created when the land is cooler than the water such as at night and surface winds have to be very light. Sea breezes are formed by increasing temperature differences between the land and water. • Mountain breezes result during the day when the land on the mountain heats the air above it more quickly than the valley floor is able to heat the air above it. Valley breezes result when this warm air expands and forms a low pressure cell at the top of the mountain.
Assessments/ Products	Students will be assessed based on their laboratory work, quizzes, tests, individual and group assessments and a culminating performance task. **Labs/Demos/Projects:** ○ Radiation Fluxes ○ Net Surface Radiation and Other Energy Fluxes ○ Shortwave Radiation ○ Long-wave Radiation ○ Other Factors Influencing Temperature **Notebooks:** **Content Notes** (every day or close to it): Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). **Vocabulary:** Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. **Narrative and Explanatory Essay** (in response to one or more Essential and Guiding Questions)/Investigation Reports: Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
Texts, Materials, and Resources	• Youtube (Coriolis Effect, Global Winds, ocean currents, space weather, layers of the atmosphere, land vs. sea breezes, etc.) • Climate Science Resources (University of Massachusetts, Lowell) • Exercises for Weather and Climate • Earth Networks weather system • Earth Networks “Achieve” standards based lessons • Science Daily Meteorology

	Course Title **Course Description** **Length of Course (semester long, or year-long)**	
Essential Questions	*Why do we have seasons?* *What factors determine seasonal temperature variations?* *During a cold calm sunny day, why do we feel warmer than the thermometer indicates?* *How do various types of precipitation form?* *Why would changing the axis tilt change weather in the northern and southern hemispheres?* *Why do clouds change shapes? How do they form?* *What can cloud observations tell us about weather?* *What air masses cause weather in the U.S?*	
Unit Three: The Seasons Revolution of the Earth around the Sun Inclination of the Earth's axis The Equinoxes and Solstices **Standards**	P1 **1.4** Provide examples of how the unequal heating of Earth and the Coriolis effect influence global circulation patterns, and show how they impact Massachusetts weather and climate (e.g., global winds, convection cells, land/sea breezes, mountain/valley breezes).	
Concepts and Skills	Students apply the concepts of temperature that they have studied in the past section and apply it to a global radiation budget Students learn that temperature can be influenced by sun angle as well as the color and texture of the Earth's surface Students consider the changes in Earth's atmospheric processes as a result of differences in energy from one place to another.	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **CCR Reading Standards** CCRSL.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCRSL.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. **CCR Writing Standards** CCWSL.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **CCR Math Standards** CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. CCSS.Math.Content.7.SP.C.6 approximate the probability of a chance event by collecting data on the

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Content Objectives	•The earth's rotation axis makes an angle of about 66.5 degrees with the plane of its orbit around the sun, or about 23.5 degrees from the perpendicular to the ecliptic plane. • An equinox occurs twice a year(Spring and Fall), when the tilt of the Earth's axis is inclined neither away from nor towards the Sun, the center of the Sun being in the same plane as the Earth's equator. Whereas the solstices occur twice each year when the Sun's apparent position in the sky, as viewed from Earth, reaches its northernmost or southernmost extremes.	
Assessments/ Products	Students will be assessed based on their laboratory work, quizzes, tests, individual and group assessments and a culminating performance task. **Labs/Demos/Projects:** ○ The Global Energy Budget and Temperature ○ Albedo (Reflectivity) ○ Net Radiation and Circulation **Notebooks:** **Content Notes** (every day or close to it): Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). **Vocabulary:** Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. **Narrative and Explanatory Essay** (in response to one or more Essential and Guiding Questions)/Investigation Reports: Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?	

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	Course Title **Course Description** **Length of Course (semester long, or year-long)**	
Essential Questions	*What conditions are needed to set up: Thunderstorms, Tornadoes, Hurricanes, and Blizzards?* *How do they know where it will rain vs. snow?* *Why do T-storms happen in the late afternoon?* *Why do so many tornadoes happen in the mid-west?* *How does hail form?* *Does lightning ever strike twice?* *Why don't we have many hurricanes in New Jersey? What is the difference between a hurricane and a tropical storm?*	
Unit Four: Frontal Boundaries Cyclonic Storms (Hurricanes (Typhoons, Cyclones), Tornadoes) Thunderstorms Winter storms [nor'easters] Impact of humans (storm preparation) **Standards**	**1.6** Describe the various conditions associated with frontal boundaries and cyclonic storms and their impact on human affairs, such as storm preparations.	
Concepts and Skills	Students learn that when water changes phase, water either releases or consumes energy. Students learn that there are several ways to measure atmospheric moisture at a given time and place. Students study how vapor pressure, mixing ratio and saturation help us to better understand atmospheric	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **CCR Reading Standards** CCRSL.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a

	moisture, Students learn another important measure of atmospheric moisture, dew point.	complex process, phenomenon, or concept; provide an accurate summary of the text. CCRSL.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. **CCR Writing Standards** CCWSL.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **CCR Math Standards** CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. CCSS.Math.Content.7.SP.C.6 approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. CCSS.Math.Content.8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. CCSS.Math.Content.8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
Content Objectives	Temperature and pressure variations in air masses result in a variety of different forms of weather, violent or otherwise. Students learn that: • Fronts or frontal boundaries result when two different air masses approach each other. The zone where these air masses meet is called a frontal boundary. • Cyclonic storms are areas of closed, circular fluid motion rotating in the same direction as the Earth. • Thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. • Nor'easter characteristics are very similar to a hurricane. More specifically it describes low-pressure areas whose center of rotation is just off the East Coast and whose leading winds in the left forward quadrant rotate onto land from the northeast. • Human lives are directly (as well as indirectly) impacted by these storms and adequate preparation can mean the difference between being a casualty or a survivor.	
Assessments/ Products	Students will be assessed based on their laboratory work, quizzes, tests, individual and group assessments and a culminating performance task. **Labs/Demos/Projects:** ○ Latent Heat	

	○ Measures of Atmospheric Moisture ○ Relative Humidity ○ Dew Point **Notebooks:** **Content Notes** (every day or close to it): Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). **Vocabulary:** Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. **Narrative and Explanatory Essay** (in response to one or more Essential and Guiding Questions)/Investigation Reports: Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?
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