Massachusetts Sample Strand Map - WEATHER & CLIMATE (October 2016)

Based on the Massachusetts Strand Map: PreK-12 Weather and Climate available at: http://www.doe.mass.edu/stem/standards/StrandMaps.html
Please direct comments, suggested edits, and questions to Jane Heinze-Fry by email: jahfry@mits.org
The standards with full clarification statements and state assessment boundaries are available at: http://www.doe.mass.edu/frameworks/scitech/2016-04.pdf
(*) denotes integration of technology/engineering through a practice or core idea.

Pre-Kindergarten (3–4 years old)

Kindergarten (5 year old)

Grade 1

Grade 2

Grade 3

Grade 4

Grade 5

Grade 6

Grade 7

Grade 8

High School

PreK-ESS2-4(MA). Use simple instruments to collect and record data on elements of daily weather, including sun or clouds, wind, snow or rain, and higher or lower temperature.

PreK-ESS2-5(MA). Describe how local weather changes from day to day and over the seasons and recognize patterns in those changes. Clarification Statement: Descriptions of the weather can include sunny, cloudy, rainy, warm, windy, and snowy.

PreK-ESS2-6(MA). Provide examples of the impact ofweather on living things. Clarification Statement: Make connections between the weather and what they wear and cando and the weather and the needs of plants and animals for water and shelter.

Math: K.CC.1

K-ESS2-1. Use and share quantitative observations of local weather conditions to describe patterns over time. Clarification Statements: Examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month, and relative temperature. Quantitative observations should be limited to whole numbers.

ELA: W.K.2

K-ESS3-2. Obtain information about the purpose of weather forecasting to prepare for, and respond to, different types of local weather.

K-PS1-1 (MA). **Investigate and communicate the idea that different kinds of materials can be a solid or liquid depending on temperature.** Clarification Statements: Materials chosen must exhibit solid and liquid states in a reasonable temperature range for Kindergarten students (e.g., 0-80 F), such as water, crayons, or glue sticks. Only a qualitative description of temperature such as hot, warm, and cool, is expected.

Math: 1.MD.4

1-ESS1-2. Analyze provided data to identify relationships among seasonal patterns of change, including sunrise and sunset time changes, seasonal temperature and rainfall or snowfall patterns, and seasonal changes to the environment. Clarification Statement: Examples of seasonal changes to the environment can include foliage changes, bird migration, and differences in amount of insect activity.

K-PS1-1.

ELA: W.2.9

2-ESS2-3. Use examples obtained from informational sources to explain that water is found in the ocean, rivers and streams, lakes and ponds, and may be solid or liquid.

3-ESS3-1. Evaluate the merit of a design solution that reduces the damage caused by weather.* Clarification Statement: Examples of design solutions to a weather-related hazard could include a barrier to prevent flooding, a wind-resistant roof, and a lightning rod.

Math: 3.MD.3

3-ESS2-1. Use graphs and tables of local weather data to describe and predict typical weather during a particular season in an area. Clarification Statements: Examples of data could include average temperature, precipitation, wind direction, and wind speed. Graphical displays should focus on pictographs and bar graphs. State Assessment Boundary: Climate change is not expected in state assessment.

ELA: W.3.7

3-ESS2-2. Obtain and summarize information about the climate of different regions of the world to illustrate that typical weather conditions over a year vary by region.

3-LS4-4. Analyze and interpret data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce. Clarification Statements: Environmental changes should include changes to landforms, distribution of water, climate, and availability of resources. Time: season to decade; Focus: 1 change

Math: 3.MD.3

5-ESS2-2. Describe and graph the relative amounts of salt water in the ocean; fresha water in lakes, rivers, and groundwater, and fresh water frozen in glaciers and polar ice caps to provide evidence about the availability of fresh water in Earth's biosphere. State Assessment Boundary: Inclusion of the atmospheres not expected in state assessment.

ELA: W.5.2

5-ESS2-1. Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation. State Assessment Boundary: Transpiration or explanations of mechanisms that drive the cycle are not expected in state assessment.

5-PS1-1. Use a particle model of matter to explain common phenomena involving gases, and phase changes between gas and liquid and between liquid and solid. Clarification Statement: Examples of common phenomena the model should be able to describe include adding air to expand a balloon, compressing air in a syringe, and evaporating water from a salt water solution. State Assessment Boundary: Atomic-scale mechanisms of evaporation and condensation or defining the unseen particles are not expected in state assessment.

ELA: W.5.9

5-PS2-1. Support an argument with evidence that the gravitational force exerted by Earth on objects is directed toward Earth's center. State Assessment Boundary: Mathematical representations of gravitational force are not expected in state assessment.

Math: 6.RP.3(MA)

6.MS-PS1-7 (MA). Use a particulate model of matter to explain that density is the amount of matter (mass) in a given volume. Apply proportional reasoning to describe, calculate, and compare relative densities of different materials.

Math: 7.RP.2

7.MS-PS3-4. Conduct an investigation to determine the relationships among the energy transferred, how well the type of matter retains or radiates heat, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. State Assessment Boundary: Calculations of specific heat or the total amount of thermal energy transferred are not expected in state assessment.

7.MS-ESS2-4. Develop a model to explain how the energy of the sun and Earth's gravity drive the cycling of water, including changes of state, as it moves through multiple pathways in Earth's hydrosphere. Clarification Statement: Examples of models can be conceptual or physical. State Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not expected in state assessment.

4-ESS3-1

5-ESS3-1

7.MS-LS2-5

ELA: WHST.6-8.1

7.MS-ESS3-4. Construct an argument supported by evidence that human activities and technologies can be engineered to mitigate the negative impact of increases in human population and per-capita consumption of natural resources on the environment. Clarification Statements: Arguments should be based on examining historical data such as population graphs, natural resource distribution maps, and water quality studies over time. Examples of negative impacts can include changes to the amount and quality of natural resources such as water, mineral, and energy supplies.

3-LS4-4

5-PS3-1

5-LS2-1

Math: 6.RP.1

7.MS-LS2-1. Analyze and interpret data to provide evidence for the effects of periods of abundant and scarce resources on the growth of organisms and the number of organisms (size of populations) in an ecosystem.

3-LS4-3

7.MS-LS2-4. Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations. Clarification Statement: Focus should be on ecosystem characteristics varying over time, including disruptions such as hurricanes, floods, wildfires, oil spills, and construction.

7.MS-ESS3-4

7.MS-ETS1-2

7.MS-LS2-5. Evaluate competing design solutions for protecting an ecosystem. Discuss benefits and limitations of each design.* Clarification Statements: Examples of design solutions could include water, land, and species protection, and the prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.

8.MS-ESS1-1b. Develop and use a model of the Earth-sun system to explain the cyclical pattern of seasons, which includes the Earth's tilt and differential intensity of sunlight on different areas of Earth across the year. Clarification Statement: Examples of models can be physical, graphical, or conceptual.

8.MS-ESS2-5. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local weather. Clarification Statements: Data includes temperature, pressure, humidity, precipitation, and wind. Examples of patterns can include air masses flow from regions of high pressure to low pressure, how sudden changes in weather can result when different air masses collide. Data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through field observations or laboratory experiments. State Assessment Boundary: Specific names of cloud types or weather symbols used on weather maps are not expected in state assessment.

8.MS-ESS2-6. Describe how interactions involving the ocean affect weather and climate on a regional scale, including the influence of the ocean temperature as mediated by energy input from the sun and energy loss due to evaporation or redistribution via ocean currents. Clarification Statement: A regional scale includes a state or multi-state perspective. State Assessment Boundary: Koppen Climate Classification names are not expected in state assessment.

8.MS-ESS3-5. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century. Clarification Statements: Examples of human activities include fossil fuel combustion, deforestation, and agricultural activity. Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities.

Math: Alg 1 F1F.4

ELA: 9-10.WHST.2

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems over different time scales result in changes in climate. Analyze and interpret data to explain that long-term changes in Earth's tilt and orbit result in cycles of climate change such as Ice Ages. See URL above for clarification.

Math: 8.F.B.5

HS-ESS3-3. Illustrate relationships among management of natural resources, the sustainability of human populations, and biodiversity. See URL above for clarification.

ELA: 9-10.WHST.1

HS-ESS3-1. Construct an explanation based on evidence for how the availability of key natural resources and changes due to variations in climate have influenced human activity. See URL above for clarification.

HS-LS1-5. Use a model to illustrate how photosynthesis uses light energy to transform water and carbon dioxide into oxygen and chemical energy stored in the bonds of glucose and other carbohydrates. See URL above for clarification.

HS-ESS2-6. Use a model to describe cycling of carbon through the ocean, atmosphere, soil, and biosphere and how increases in carbon dioxide concentrations due to human activity has resulted in gradual atmospheric and climate changes.

Math: 6.EE.9

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's hydrosphere can create feedbacks that cause changes to other Earth systems. Clarification Statement: Examples can include how decreasing the amount of glacial ice reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. See URL above for more clarification.

HS-ESS3-5. Analyze results from global climate models to describe how forecasts are made of the current rate of global or regional climate change and associated future impacts to Earth systems. Clarification Statement: Climate model outputs include both climate changes (such as precipitation and temperature) and associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).

7.MS.ETS1-2

Math: 6RP.A.1,2,3b

HS-ESS3-2. Evaluate competing design solutions for minimizing impacts of developing and using energy and mineral resources, and conserving and recycling those resources, based on economic, social, and environmental cost-benefit ratios.* See URL above for clarification.

Math: F-LE.1, F-LE.5

HS-ESS2-6

HS-LS2-4. Use a mathematical model to describe the transfer of energy from one trophic level to another. Explain how the inefficiency of energy transfer between trophic levels affects the relative number of organisms that can be supported at each trophic level and necessitates a constant input of energy from sunlight or inorganic compounds from the environment. See URL above for clarification.

HS-LS2-5. Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere. See URL above for clarification.

HS-LS2-1. Analyze data sets to support explanations that biotic and abiotic factors affect ecosystem carrying capacity. Clarification Statements: . . . Examples of abiotic factors could include climate and weather conditions. . . See URL above for more clarification.

Math: S-ID.A.1,2,3

HS-LS2-2. Use mathematical representations to support explanations that biotic and abiotic factors affect biodiversity, including genetic diversity within a population and species diversity within an ecosystem. Clarification Statements: . . . Examples of abiotic factors could include climate and weather conditions... See URL above for more clarification.

ELA: WHST.9-10.1

HS-LS2-6. Analyze data to show ecosystems tend to maintain relatively consistent numbers and types of organisms even when small changes in conditions occur but that extreme fluctuations in conditions may result in a new ecosystem. Construct an argument with evidence that ecosystems with greater biodiversity tend to have greater resistance to change and resilience. Clarification Statement: Examples of changes in ecosystem conditions could include extreme changes, such as volcanic eruption, fires, climate changes, ocean acidification, or sea level rise. See URL above for more clarification.

8.MS-ESS3-5

ELA:WHST.9-10.9

HS-LS2-7. Analyze direct and indirect effects of human activities on biodiversity and ecosystem health, specifically habitat fragmentation, introduction of non-native or invasive species, overharvesting, pollution, and climate change. Evaluate and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.* See URL above for clarification.

PreK-ESS3-2(MA). Observe and discuss the impact of people's activities on the local environment.

PreK-LS2-2(MA). Using evidence from the local environment explain how familiar plants and animals meet their needs where they live. Clarification Statements: Basic needs include water, food, air, shelter, and, for most plants, light. Examples of evidence can include squirrels gathering nuts for the winter and plants growing in the presence of sun and water. The local environment includes the area around the student's school, home, or adjacent community.

PreK-LS2-3(MA). Give examples from the local environment of how animals and plants are dependent on one another to meet their basic needs.

Math: 2.MD.10

2-LS2-3(MA). Develop and use models to compare how plants and animals depend on their surroundings and other living things tomeet their needs in the places they live. Clarification Statement: Animals need food, water, air, shelter, and favorable temperature; plants need sufficient light, water, minerals, favorable temperature, and animals or othermechanisms to disperse seeds.