Teaching Progression for Sea Level Rise based on the Next Generation Science Standards (NGSS)
September, 2013

Table 1. Measuring and Modeling the Causes and Effects of Sea Level Rise

Level of Achievement	NGSS Performance Expectation	Draft Teaching Progression Language
4 (Upper Anchor)	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition. Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution. (HS-ESS2-4) Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. Clarification Statement: Emphasis is on the idea that different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias. Assessment Boundary: Assessment is limited to qualitative descriptions. (HS-PS4-4) 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. Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition). Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts. (HS-ESS3-5)	To be added later

3	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical. Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed. (MS-ESS2-4) Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium. (MS-PS1-4) Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added. Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred. (MS-PS3-4)	
2	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system. Assessment Boundary: Assessment is limited to the interactions of two systems at a time. (5-ESS2-1) Develop a model to describe that matter is made of particles too small	

	to be seen. Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water. Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles. (5-PS1-1) Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow. Assessment Boundary: Assessment is limited to a single form of weathering or erosion. (4-ESS2-1) Make observations to determine the effect of sunlight on Earth's surface. Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water. Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler. (K-PS3-1)	
1 (Lower Anchor)	n/a	Undefined
0	n/a	No knowledge or understanding

Table 2. Investigating the Human Causes and Effects of and Adaptation to Sea Level Rise

Level of Achievement	NGSS Performance Expectation	Draft Teaching Progression Language
4 (Upper Anchor)	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids). (HS-ESS2-5) 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. Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised. (HS-ESS3-1) Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate or a seasonal flood; and, extreme changes, such as volcanic eruption or sea level rise. (HS-LS2-6)	To be added later

3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land). (MS-ESS3-3) Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes. (MS-ESS3-4)	
2	Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land. (2-ESS2-1) Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow. Assessment Boundary: Assessment is limited to a single form of weathering or erosion. (4-ESS2-1)	
1 (Lower Anchor)	n/a	Undefined
0	*n/a*	*No knowledge or understanding*