

**NERRS Estuaries 101 Middle School Curriculum**

**Activity 1: Where Rivers Meet the Sea (Exercise 3 does not meet standards)**

**Next Generation Science Standards (NGSS) Alignment**

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Analyzing and Interpreting Data</b>                      Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.                      • Analyze and interpret data to determine similarities and differences in findings.  <i>Students use data from a sea surface temperature map to examine where the temperatures of ocean water are warmest or coolest near estuaries. [Exercise 2]</i>  <i>Students use sea surface temperature map to determine movement of ocean currents. [Exercise 2, Climate Extension]</i></p> <p><b>Constructing Explanations and Designing Solutions</b>                      Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.                      • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future.  <i>Students construct explanations of estuaries using the Map of Mobile Bay. Students use The Four Types of Estuaries student page to categorize Mobile Bay and Jobos Bay. Students define an estuary using website. [Exercise 1]</i>  <i>Students explain sea water temperature in relation to the equator. [Exercise 2]</i>  <i>Students discuss why there isn't enough data to prove climate change, what more data is needed. Students predict sea surface temperature in 2019 based on maps from 2 time periods. How will warmer ocean temperatures impact estuarine ecosystems and how do they influence different types of estuaries? [Exercise 2, Climate Extension]</i></p>	<p><b>ESS2.C: The Roles of Water in Earth’s Surface Processes</b>                      • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)                      • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)                      • Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create 3 underground formations. (MS-ESS2-2)  <i>Students learn how estuaries are formed. The formation of estuaries is largely dependent on changes to the earth’s surface due to water (sand bar formation, fjords, delta sediment movement, etc.). [Exercise 1]</i></p> <p><b>ESS2.D: Weather and Climate</b>                      • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)  <i>The exercise discusses the role the ocean plays in moving warmer water to the poles and ocean currents which make that happen. Students must also predict the temperature in estuaries dependent upon their location. [Exercise 2]</i>  <i>The role that the oceans currents play as a climate regulator. [Exercise 2, Climate Extension]</i></p> <p><b>ESS3.D: Global Climate Change</b>                      • Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge,</p>	<p><b>Patterns</b>                      • Patterns can be used to identify cause and-effect relationships.  <i>Students look at patterns in sea level temperature to determine movement of ocean currents. [Exercise 2, Climate Extension]</i>                      • Graphs, charts, and images can be used to identify patterns in data.  <i>Students compare and contrast different types of estuaries, recognizing the patterns of each type. [Exercise 1]</i>  <i>Students look at patterns in sea level temperature to determine movement of ocean currents. [Exercise 2, Climate Extension]</i></p> <p><b>Cause and Effect: Mechanism and Explanation</b>                      • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.  <i>Students examine the effects of geographic location on ocean water temperature and of ocean water temperature on water temperature within the connected estuaries. [Exercise 2]</i>  <i>Relationship between sea level temperature and ocean currents. [Exercise 2, Climate Extension]</i></p> <p><b>Energy and Matter: Flows, Cycles, and Conservation</b>                      • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.(MS-ESS2-4)  <i>Students look at how the heated ocean temperatures are cycled through the system. [Exercise 2]</i>  <i>The ocean stores excess heat energy. [Exercise 2, Climate Extension]</i></p> <p><b>Stability and Change</b>                      • Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)  <i>Students use maps to examine how changes in ocean temperatures will alter ocean currents and estuarine temperatures. [Exercise 2, Climate Extension]</i></p>

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	<p>such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)</p> <p><i>In the extension students analyze and predict how rising ocean temperature would affect overall world-ocean temperature through currents and the effect on estuaries. To make a strong connection, teacher would need to discuss ways in which humans contribute to climate change and make the link to rising ocean temperatures.</i></p> <p>[Exercise 2, Climate Extension]</p>	