



Estuaries 101 Middle School Curriculum

Estuary education enhances math and science skills.

Estuary education supports interdisciplinary learning.

Estuaries offer a wonderfully rich context for science education.



NATIONAL
ESTUARINE
RESEARCH
RESERVE
SYSTEM



CURRICULUM OVERVIEW

Estuaries 101 Middle School Curriculum

Foreword

Recognizing the incredible power of estuaries to provide a rich environment for learning, exploration, and discovery, NOAA's National Estuarine Research Reserve Education Coordinators developed the Estuaries 101 Middle School Curriculum. We invite you to review it and use it in your classrooms. This Curriculum is designed to facilitate teacher and student understanding of the key principles and fundamental concepts of estuarine ecology and foster understanding of the role estuaries play in the lives of humans and other organisms.

The Estuaries 101 Middle School Curriculum is a new multimedia curriculum focused on the theme "Estuaries & You." It includes a series of online activities for middle school students that highlight our nation's "living laboratories", all 28 estuaries that make up NOAA's National Estuarine Research Reserve System. This new series of activities is built around real-world events, uses scaffolding, visualization and analysis tools, promotes use of multimedia elements, and encourages reflection opportunities. This Estuaries 101 Middle School Curriculum is a natural complement to the [Estuaries 101 High School Curriculum](#), the [NOAA Chesapeake Bay Exploration Curriculum](#) and to the [NOAA Data in the Classroom Water Quality Module](#).

Estuaries offer a wonderfully rich context for science education and interdisciplinary learning to take place. With this new Estuaries 101 Middle School Curriculum:

Students will:

- Use various multimedia resources to explore and understand the role estuaries play in the lives of humans and other organisms.
- Learn about real scientific research stories from among the 28 Reserves.
- Query observational platforms throughout the 28 Research Reserves from their classroom or home.

Teachers will:

- Use research questions to guide student problem-solving within the context of curriculum lessons
- Participate in on-line web-seminars and *Teachers on the Estuary* trainings held at the various Research Reserves

It is our expectation that by using the Estuaries 101 Curriculum, students will gain an appreciation for the importance of estuaries in their lives and learn how their behavior impacts coastal ecosystems. We believe it is of utmost importance to prepare tomorrow's leaders to make sound decisions about the environment and the nation's oceans and coasts. Students must understand the crucial

This curriculum was developed and produced for:

The National Oceanic and Atmospheric Administration (NOAA) and The National Estuarine Research Reserve System (NERRS)

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connection between estuaries, coastal, and upland areas, and the effects of a growing population.

Purpose & Goal

With the many threats that our nation's oceans face, it is time for a new era of ocean literacy and enhanced efforts to prepare today's children to be tomorrow's ocean stewards. Estuaries are an ideal topic to excite students about studying the ocean because of the strong personal connections people have with estuaries — from treasured recreation experiences, scenic views during transits, to making a living on the water. Advancing estuary, ocean and climate literacy is a priority of NOAA's National Estuarine Research Reserve System (NERRS). It is our expectation that, through the Estuaries 101 Curriculum, students and teachers will gain an understanding of the great importance of estuaries and the intricate connections it has with the ocean and climate systems.

The goal of Estuaries 101 is for students and teachers throughout the nation to become more ocean literate by increasing their knowledge of coastal and estuarine science and how estuaries affect their daily lives. To achieve this increased literacy, teachers will use the Estuary Education website at estuaries.noaa.gov and multimedia curriculum activities to introduce students to an online interface for accessing real-time and archived estuarine monitoring data (from [NERRS' System Wide Monitoring Program](#)). Use of the Estuaries 101 Curriculum will be supported through professional development trainings hosted at 28 Reserves and at professional meetings across the nation.

Using the Estuaries 101 curriculum, teachers will be able to teach their students about Earth System Science using estuaries as context. Through this curriculum — which includes videos, interactive web pages, maps and data graphing tools — teachers and students will learn that estuaries provide shelter, spawning grounds, and food for many species; that they act as buffers to improve water quality, reduce the effects of floodwaters, and prevent erosion; and that coastal areas provide value to humans in the form of recreation, scientific knowledge, aesthetics, commercial and recreational fishing, and transportation.

Why teach about estuaries?

Estuaries offer a wonderfully rich context for science education and inter-disciplinary learning.

Estuaries are dynamic environments with a daily flux of ocean flows mingling with river water, creating a remarkably diverse range of life and ecosystems. As a result, they offer learners a convergence of such fields as Earth systems science, biology, chemistry, geography, geology and marine science. For example, students develop math skills through detailed measurements, modeling phenomena such as growth and cyclical variation, and analyzing data to make comparisons across multiple estuaries. They develop language skills as they read and write about estuary-related topics and communicate their explorations and findings with other students and scientists. Since estuaries have also played a significant role in human settlement, exploration and development, students gain new eyes on human history, geography and culture.

Estuaries as a Vehicle for Studying Big Ideas in Earth, Life and Physical Science.

Estuaries-related education can help students understand and apply “big ideas” in science. For example, students learn about diverse habitats and how life adapts to them, daily and annual cycles of change, the physical properties of water, and so on. Estuaries provide engaging and accessible examples of these processes at work. Estuaries also integrate key concepts in biology (e.g. habitat adaptations), chemistry (e.g. salinity analysis) and physics (e.g. wave motions). Estuaries can provide a powerful context for learning these big ideas. While estuaries are hardly the only context for learning such big ideas, they are a rich and fertile one, supporting a study of many key ideas in Earth, life and physical science.

Estuaries as a Context to Develop Scientific Thinking Skills.

The Estuaries 101 modules help students develop science thinking skills, in addition to content knowledge. Students learn to design and conduct experiments, conduct field observations, analyze data, use spreadsheets, visualizations and other technological tools, work effectively in teams, prepare research reports, and communicate findings to others. These skills are an essential element of effective science education, and well represented in the Estuaries 101 Curriculum.

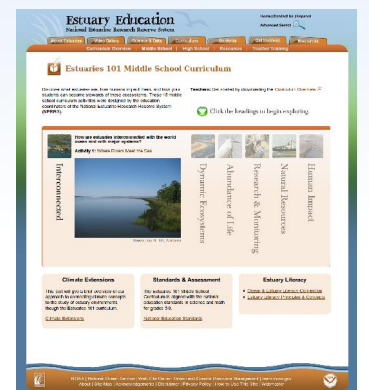
Curriculum Components

About the Activities & Multimedia Components

The Estuaries 101 Middle School Curriculum is a multimedia curriculum focused on the theme “Estuaries & You.” It includes 15 online activities for middle school students that highlight our nation's “living laboratories,” all 28 estuaries that make up NOAA's National Estuarine Research Reserve System. All of the instructional tools that make-up the curriculum are conveniently located in the Middle School Curriculum section of the Estuary Education website estuaries.noaa.gov.

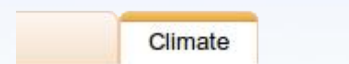
- **Estuaries.noaa.gov provides access to each learning experience and tools** featuring such components as: 15 Estuary Activities, 6 Climate Extensions, Standards and Assessments, Print Activities, Videos, Interactive Web pages and Simulations, Estuary Literacy, Interactive Maps and Graphing Tools.
- The activities are organized under 6 major estuary principles or goals and include two to three exercises and self-assessment activities. **The activities follow the same basic structure:**
 - Teacher Guide, including an overview, learning objectives, background information, materials and preparations, procedures, teacher master sheet detailing the exercises, time required for completion, vocabulary, and extensions
 - Student Master Sheet
 - Formal Assessment Sheet
- Each Activity concludes with **assessment** questions, designed for use after completion of the activity. These assessments provide a means for both grading, as appropriate, and checking in with student advances in understanding.

You'll find multimedia and other resources for each activity in the Middle School Curriculum section of the Estuary Education website:
<http://estuaries.noaa.gov>.



- A number of activities include “**Climate Extensions.**” Because one of the most pressing issue facing estuaries today is climate change, woven throughout this curriculum are activity extensions that help students understand *why* and *how* climate change is impacting estuaries. The overall objective of the climate extensions is for your students to be able to identify two ways the climate is changing, three ways climate change is impacting estuaries and discuss ways in which students can be part of the solution. A climate extension is added to one activity from each main estuary principle for a total of six climate extensions. A climate change interactive can be found on the website to support the teaching of the concepts captured under the climate extensions.
- **Interactive Maps** are used to compare environmental conditions in different estuaries around the National Estuarine Research Reserve System (NERRS). The maps can be found on the web pages that feature Activities that utilize them as a tool to collect data.
- A number of activities promote data explorations. This **System-wide Monitoring Program (SWMP) data graphing application** can be found on the web pages that feature Activities that utilize this graphing application. Use of this tool is supported by two video tutorials.
- All activities are supported by a series of **multimedia components**. There are videos, images or visualizations that can be viewed on estuaries.noaa.gov and can be found under each tab where the activities are located.

For resources and links related to the Climate Extensions, look for the Climate tab on selected activity web pages in the Middle School Curriculum section of the Estuary Education website: <http://estuaries.noaa.gov>.



Alignment with Education Standards

The Estuaries 101 Middle School Curriculum Activities are aligned with the National Education Science and Mathematics Standards for grades 5-8. All standards can be viewed either from the Middle School Curriculum homepage or from specific Activity web pages.

The curriculum is divided into 6 Units based on the six Estuary Literacy Principles. Each Estuary Literacy Principle highlights a Science Education Standard: Principle 1 is based on Earth and Space Science; Principle 2 is based on Physical Science and Earth and Space Science; Principle 3 is based on Life Science; Principle 4 is based on Inquiry and Science and Technology; Principle 5 is based on Science and Natural Resources; and Principle 6 is based on Personal and Social Perspectives. The math content is an integral part of the curriculum as well and is correlated to the National Principles and Standards for School Mathematics to help students use their math skills in the context of a science program.

Alignment with the Estuaries Principles & Concepts

The NERRS educators defined a set of “core” principles and concepts about estuaries that students need to master in order to become estuary literate, as embodied in the [Estuaries Literacy Principles and Concepts](#) for Estuaries 101. There are six specific fundamental principles – the “big ideas” – about estuaries and their connections to the world around us. These principles were used to guide the design of the Estuaries 101 Middle School Curriculum.

Technical Requirements

The Estuary Education website is optimized for a 1028 x 768 pixel screen resolution and for the following browser versions: Internet Explorer (6.0 or higher), Firefox (1.5 or higher), or Safari (2 or higher). Earlier browser versions may not display optimally onscreen and may not run some enhanced features of the site. Cookies and JavaScript must both be enabled in your browser.

Plug-Ins

Plug-ins are software programs that extend the capabilities of your Web browser, giving you the ability to perform special functions using your browser; for example, view videos and play audio.

- Adobe Reader — PDF document viewing program
- Adobe Flash Player — Browser plug-in for videos, animation, interactivity and sound

Estuaries 101 Middle School Curriculum Map

Research Question	Activities	Learning Objectives	Estuaries	Climate Extension Objective
Principle 1: Estuaries are interconnected with the world ocean and with major systems and cycles on Earth.				
What are estuaries?	<p>Activity 1: Where Rivers Meet the Sea</p> <p>Students are introduced to the Estuaries 101 program and website. Here they take a short, online quiz to check their initial estuary knowledge, examine Mobile Bay as an example of an estuary and practice identifying different types of estuaries.</p>	<p><u>Students will understand that:</u></p> <ul style="list-style-type: none"> An estuary is a body of water, partially enclosed by land, where salt water from the ocean and fresh water from the land can mix. Estuaries can be found in coastal areas of the ocean worldwide. The National Estuarine Research Reserves (NERRS) are a system of estuary sites located around the coasts the United States and Puerto Rico and the Great Lakes that set the baseline for research and monitoring in estuaries. 	<p>Weeks Bay NERR, AL</p> <p>Jobos Bay NERR, PR</p>	<p><i>Students will:</i></p> <ul style="list-style-type: none"> Describe the relationship between ocean temperatures and ocean currents. Make predictions about Sea Surface Temperature by linking satellite data to concerns about global climate change. Describe the impacts of warming ocean temperatures on estuaries.
Principle 2: Estuaries are dynamic ecosystems with tremendous variability within and between them in physical, chemical, and biological components.				
What are the physical (geographic, weather and climate) factors that influence and regulate life in the estuaries?	<p>Activity 2: Seasonal Swings</p> <p>Students will learn about the NERRS System using an online map that has a brief description about each of the 28 Reserves. By comparing and contrasting data from two Reserves, students will understand that extreme air and water temperature differences are related to their geographic location, particularly their latitudes relative to each other.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Weather can affect water properties. Seasonal changes in weather and a Reserve's proximity to the equator or the poles create conditions that cause variety amongst the nation's estuaries. 	<p>Eikhorn Slough NERR, CA</p> <p>Kachemak Bay NERR, AK</p>	<p><i>No climate extension</i></p>

Research Question	Activities	Learning Objectives	Estuaries	Climate Extension Objective
<p>How do tides, wind, geographic processes, and site topography directly affect the nation's estuaries?</p>	<p>Activity 3: Water Going Up, Water Going Down</p> <p>Students will examine the effects of tides on estuaries, and look at data to understand the effect on dissolved oxygen levels before and after a mouth closure.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Both lunar tides and wind-driven seiches affect water levels in estuaries. Movement of sediment at the mouth of an estuary will either open or close the estuary's access to its lake or ocean. Tides vary throughout the day from location to location. Lack of tidal flushing can cause water conditions, such as dissolved oxygen, in a lagoon to deteriorate. This can harm aquatic life inside the estuary. If an estuary mouth is unable to open naturally, it is sometimes necessary to open the mouth artificially by dredging. There is a distinction between global sea level trends and local sea level trends. Sea levels provide an important key to understanding the impact of climate change on estuaries. 	<p>Tijuana River NERR, CA Old Woman Creek NERR, OH Kachemak Bay NERR, AK</p>	<p><i>Students will:</i></p> <ul style="list-style-type: none"> Use online sea level maps and explore variation in sea level trends across the National Estuarine Research Reserves.
<p>Principle 3: Estuaries support an abundance of life, and a diversity of habitat types.</p>				
<p>What role do plants and animals play in the estuary food pyramid?</p>	<p>Activity 4: Estuary Food Pyramid</p> <p>Students will construct an example of a food pyramid for estuary organisms and examine this flow of energy.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> There are three major categories of living organisms in an ecosystem and each has a special role. They are: producers, consumers, and decomposers. The food energy produced by producers is cycled through the ecosystem through food chains and complex food webs by way of a series of energy levels called trophic levels. Energy is lost as it flows through the ecosystem. A food pyramid reflects fewer and fewer organisms at each level, supported by larger numbers of organisms at the trophic level just below. Students will learn that climate change has the potential for far reaching effects within marine food webs. 	<p>No Research Reserves referenced directly in the activities</p>	<p><i>Students will:</i></p> <ul style="list-style-type: none"> Consider climate change potential impacts to marine food webs.

Research Question	Activities	Learning Objectives	Estuaries	Climate Extension Objective
<p>What are plankton and why are they important in the estuary?</p>	<p>Activity 5: Planet Plankton Students will learn about different types of plankton and their importance to life in estuaries.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Plankton are very small, diverse organisms. Plankton are important to Earth's atmosphere and climate. Plankton are critical to maintaining life in estuaries. 	<p>No Research Reserves referenced directly in the activities</p>	<p>No climate extension</p>
<p>What is the biological importance of the oyster reef, how are oyster reef populations threatened, and what can be done to prevent declines in oyster populations?</p>	<p>Activity 6: An Ode to the Oyster Students will sort oyster reef organisms to identify the many types of organisms that live on an oyster; create a mural showing the oyster reef and organisms; dissect an oyster and explore its anatomy; and role-play as biologists whose assignment it is to uncover what is causing the decline in an oyster population and propose a solution to the problem.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Oysters live with other organisms near the shore and can form oyster reefs. Reef oysters are adapted to live within the dynamic, stressful intertidal environment. Oysters are economically important in coastal regions. Oysters are also environmentally important in that they remove pollutants from the water and oyster reefs help protect marsh shorelines from erosion. Populations of oysters that form oyster reefs have been reduced by pollution, excess sediment in the water, over-fishing, and by loss of areas of hard substrate on which to grow. Oyster reef restoration and controls on over-harvesting of oysters can slow or stop the decline in the reef oyster population. 	<p>ACE Basin NERR, SC</p>	<p>No climate extension</p>
<p>What are the basic anatomical features of horseshoe crabs that allow them to survive in the estuary environment?</p>	<p>Activity 7: Hooray for Horseshoe Crabs Students will learn about the anatomy and unique adaptations of these amazing animals.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Horseshoe crabs are arthropods, but are not true crabs. Horseshoe crabs are benthic or bottom dwellers. Horseshoe crabs move along the bottom of the ocean or estuary using their ten legs. Horseshoe crabs leave the water to crawl onto the beach to lay their eggs in the sand. 	<p>Delaware NERR, DE</p>	<p>No climate extension</p>

Research Question	Activities	Learning Objectives	Estuaries	Climate Extension Objective
What are the basic characteristics of sharks that allow sharks to survive in the ever changing estuary environment?	<p>Activity 8: Sharks in the Estuary</p> <p>Students will examine two sharks found in estuaries (the leopard shark and the sandbar or brown shark) and identify shark features that make the sharks well suited to life in the estuary environment.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> The elasmobranchs, or cartilaginous fish, include rays, skates, and nearly 400 species of sharks. The torpedo shape of the shark helps the shark swim quickly through the water. The shape and size of the caudal fin (tail) and dorsal (back) fins provide clues about how fast a shark might swim and whether a shark is hunting for fast prey in the open ocean or slower prey in the estuary. Different sharks have different teeth depending on what they eat. In addition to the sensory network made of the lateral line system and ampullae of Lorenzini, sharks also rely on hearing, smell, and vision. 	Sapelo Island NERR, GA	<i>No climate extension</i>
How have birds adapted to survive in estuary habitats?	<p>Activity 9: Bountiful Birds</p> <p>Students will engage in a role-playing activity to model different bird beaks and then compare and contrast the great blue heron and osprey with other birds living in the estuaries.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Birds have basic needs for air, water, food, protection from predators, and a place in which to breed. Estuary habitats, such as the salt marsh and the mangrove swamp, meet the survival needs of many birds. Birds have adaptations that allow them to efficiently feed in specific estuary environments. Beaks differ in design depending on where the bird feeds and the function for which the beak is used. 	No Research Reserves referenced directly in the activities	<i>No climate extension</i>

Research Question	Activities	Learning Objectives	Estuaries	Climate Extension Objective
Principle 4: Ongoing research and monitoring is needed to increase our understanding of estuaries and to improve our ability to protect and sustain them.				
What is a "Jubilee" and what specific conditions must be present for a jubilee event to occur?	<p>Activity 10: The Jubilee Phenomenon</p> <p>Students will examine the specific conditions that must be present to cause a jubilee event.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Water quality, tides, and weather within estuaries change and can change quickly. Water stratification in estuaries is caused by density differences related to salinity and temperature. When layers of water are not sufficiently mixed, the bottom layer can become depleted of dissolved O₂. Physical changes in water temperature, salinity, and dissolved oxygen can be observed and measured. Weather conditions, such as wind direction and speed, can be observed and measured. By monitoring water quality, tide, and weather conditions, researchers may predict likely times and locations for a jubilee to occur. 	Weeks Bay NERR, AL	No climate extension
How is ongoing research and monitoring of oysters increasing our understanding of estuaries?	<p>Activity 11: The Great Oyster Mystery</p> <p>Students look for clues using data researchers used to solve the Great Oyster Mystery.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Environmental conditions, such as salinity, have a direct influence on estuary organisms. Testing hypotheses through scientific investigation helps answer questions about the natural world. 	Mission Aransas NERR, TX	No climate extension
What do research and long-term monitoring reveal about changes in estuary habitats and the animals adapted to live in those habitats?	<p>Activity 12: Migrating Mangroves and Marshes</p> <p>Students will learn about the species that live in salt marsh and mangrove habitats, and will look at data from long-term monitoring in order to understand how these habitats can change over time.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> Animals and plants have adaptations that allow them to live and thrive in different estuary habitats, such as salt marshes or mangrove habitats. Living things are affected by changes in their habitat. Habitats can expand or contract due to outside changes that affect the physical components of the habitat or the organisms that help define the habitat. Research on habitats and species ranges, coupled with long-term monitoring, can give clues to why estuary habitats change over time. 	Mission Aransas NERR, TX	<p><i>Students will:</i></p> <ul style="list-style-type: none"> Use historical data and maps to consider climate change potential impact on mangrove habitats.

Research Question	Activities	Learning Objectives	Estuaries	Climate Extension Objective
<p>Principle 5: Humans, even those living far from the coast, rely on goods and services supplied by estuaries</p>	<p>In what ways do people rely on goods and services supplied by estuaries?</p> <p>Activity 13: Port to Port</p> <p>Students will participate in a role-playing game in which they trade estuary goods with a ship's captain who travels around North America, visiting different ports in the 1800s. Then students will play a game to examine the value of estuaries and how human activities and decisions affect the estuaries and change their value.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> • Estuaries have economic value. • Estuaries also have social and cultural value. • Estuaries can be damaged by human or natural factors. • Estuaries can be restored by humans to some degree. • Climate-related impacts along the coast will shape the availability of future goods and environmental services coming from estuaries. Students will learn three ways that coastal communities can adapt to and mitigate climate change impacts. 	<p>Kachemak Bay NERR, AK</p> <p>South Slough NERR, OR</p> <p>Apalachicola NERR, FL</p> <p>Sapelo Island NERR, GA</p> <p>North Inlet-Winyah Bay NERR, SC</p> <p>Chesapeake Bay NERR, MD</p> <p>Chesapeake Bay NERR, VA</p> <p>Delaware NERR, DE</p> <p>Great Bay NERR, NH</p> <p>Hudson River NERR, RI</p> <p>Old Woman Creek NERR, OH</p>	<p><i>Students will:</i></p> <ul style="list-style-type: none"> • Explore climate change-related impacts to coastal communities and • economies through an interactive game of chance.

Research Question	Activities	Learning Objectives	Estuaries	Climate Extension Objective
<p>Principle 6: Human activities can impact estuaries by degrading water quality or altering habitats; therefore, we are responsible for making decisions to protect and maintain the health of estuaries.</p>	<p>How have humans had an impact on estuaries?</p> <p>Activity 14: Oil Spill - The Rest of the Story</p> <p>Students will exhibit their understanding of how non-point source water pollution enters the estuaries via the watershed by building a watershed model and using it to explore surface runoff, demonstrate an understanding of best management practices and how these practices influence keeping water clean by playing a game of water quality limbo, and predict possible ways to limit or prevent non-point source water pollution.</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> • A watershed or drainage basin is an area of land that delivers water run-off, sediment, and dissolved substances to surface water bodies such as rivers, lakes, or oceans. • Non-point source water pollution moves through a watershed and accumulates in lakes, oceans, and estuaries. • Polluted runoff can be prevented from getting into waterways. • Water quality standards are levels of required cleanness that are set by State and Federal agencies to ensure people's health and give guidance to maintaining the health of waterways. 	<p>Weeks Bay NERR, AL</p>	<p><i>No climate extension</i></p>
<p>How can people act as stewards of the nation's estuaries?</p>	<p>Activity 15: Score One for the Estuaries</p> <p>Students will focus on how they are all responsible for making decisions to protect and maintain the health of estuaries. Students are encouraged to asked: "What can you do to "score one" for the estuaries?"</p>	<p><i>Students will understand that:</i></p> <ul style="list-style-type: none"> • Humans can have both negative and positive impacts on the health of estuaries. • Stewardship is a way for people, including young people, to care for or maintain something such as the environment, an estuary, or wetlands. • Many people working together, even if they are young, can have a big impact on the estuaries and the wetlands. • There are a variety of stewardship activities that they can do to help lessen the impacts of climate change. 	<p>Weeks Bay NERR, AL</p> <p>Padilla Bay NERR, WA</p> <p>Narragansett Bay NERR, RI</p> <p>Apalachicola NERR, FL</p> <p>San Francisco NERR, CA</p> <p>Elkhorn Slough NERR, CA</p> <p>Sapelo Island NERR, GA</p>	<p><i>Students will:</i></p> <ul style="list-style-type: none"> • Learn how to mitigate the impacts of climate change through several example projects being implemented at the National Estuarine Research Reserves.