

Estuaries

Topics: Hudson River Estuary



Department of
Environmental
Conservation

GRADE LEVEL: High School

Big Ideas:

- The Hudson River is unique.
- There is a difference between salt, fresh and brackish water
- The Hudson River begins in Adirondack Mountains, and empties into the Atlantic Ocean.
- The Hudson River is an estuary.
- The Hudson River is a tidal river.

Learning Objectives: *students will be able to...*

- Identify what makes the Hudson River so unique.
- Compare and distinguish between fresh water, salt water and brackish water in the Hudson River.
- Analyze Hudson River data to identify tidal patterns.
- Analyze and interpret Hudson River data to locate the salt front and determine how it affects fish species distribution.
- Develop and use a model of Earth-moon systems to describe the tidal cycle.
- Analyze maps and graphs of the Hudson River to determine tidal characteristics.

New Your State Science Learning Standards:

HS-ESS1-7. Construct an explanation using evidence to support the claim that the phases of the moon, eclipses, tides, and seasons change cyclically.

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth.

HS-LS2-1. Use mathematical and/or computational representations to support explanations of biotic and abiotic factors that affect carrying capacity of ecosystems at different scales.

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS2-6. 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.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Key Understandings:

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.
- Water transports material through the Hudson River watershed and estuary.
- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center
- Global movements of water and its changes in form are propelled by sunlight and gravity.

Essential Questions:

- What are the characteristics of estuaries that make them so important to living organisms?
- How do biotic and abiotic factors influence the range of tolerance for populations of organisms in various locations in an estuary?
- How do tides impact organisms that live in the Hudson River?
- How can we use data collected by students during Day in the Life of the Hudson River to understand how water flows through the Hudson River system?
- What is an estuary?

- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
- Ecosystems are dynamic in nature; their characteristics can vary over time.
- Tides rise and fall daily in predictable patterns.
- What different types of water can be found in the Hudson River?
- How is the Hudson different from other rivers?

Students will know...

- Gravity from the sun and the moon pull on Earth's water to form tides.
- The difference between fresh, brackish and salt water.
- What an estuary is.
- The Hudson River has tides and currents.
- The salt front location in the Hudson changes due to weather.
- Key vocabulary terms.
- Tides are the periodic rise and fall of ocean waters affecting coastal areas around the world.
- The tides rise and fall daily due to the rotation of the earth.
- Tides are caused by a combination of gravitational forces from the moon and the sun.

Vocabulary:

- Brackish water: a mixture of fresh and saltwater.
- Drainage basin: any area of land where precipitation collects and drains off into a common outlet, such as into a river, bay, or other body of water.
- Estuary: a body of water in which fresh and salt water meet.
- Fresh water: water that is not salty.
- Gravity: the gravitational attraction of the mass of the earth, the moon, or a planet for bodies at or near its surface.
- Salt water: seawater or other water that contains salt.
- Tidal cycle: the alternate rising and falling of the surface of the ocean.
- Waterbody: A body of water forming a physiographic feature.
- Watershed: the area of land from which water drains into a body of water.

Learning Plan: We recommend doing these lessons in sequential order; however, they can be done as individual lessons. Lessons have multiple links (videos, songs, diagrams, activities) that can be used at the teacher's discretion depending on class time.

Pre-assess: Why do we call the Hudson the river that flows both ways? What makes the Hudson so unique? Use informational surveys/questionnaires/inventories to assess students' prior knowledge, have students write or draw in response to the essential questions.

Progress Monitoring: Formative assessment and teacher feedback should be ongoing throughout the lessons. Teachers should develop assessments based on their individual class needs. Think-pair share, exit tickets, interactive discussions, questions and listening, informal observations, quizzes and student work samples can all be used.

Lesson 1: What is an Estuary? - Students explore the components of the Hudson River ecosystem by watching a video about the Hudson, working through an online estuaries' tutorial, and exploring why estuaries are so important by researching an estuary reserve site.

- Video: [Source to Sea](#)

- [Estuaries Tutorial](#)
 - Introduction to the Hudson: A journey down the river [Student Activity](#)
 - Where Rivers Meet the Sea [Video](#), [Student Activity](#) & [Teacher Section](#)
 - Conservationist for Kids Magazine: [Explore the Hudson River](#)
-

Lesson 2: Day in the Life of the Hudson and Harbor- Students watch live footage collected in three geographic areas of the Hudson River estuary and use the accompanying worksheets to explore the Hudson. Students follow along with data collection and take a deeper dive with a guest scientist. Watch one or all three.

- [New York Harbor: Day in the Life of the Hudson and Harbor](#) and [Data Sheet](#)
 - [Lower Estuary: Day in the Life of the Hudson and Harbor](#) and [Data Sheet](#)
 - [Upper Estuary: Day in the Life of the Hudson and Harbor](#) and [Data Sheet](#)
-

Lesson 3: The Hudson's Ups and Downs- Students watch a video to build an understanding of the periodic rise and fall of surface water, and model tidal movements. Students determine how tides affect the Hudson River and create a graph showing a two-day pattern of tides in the river.

- [Tide Finder Video](#)
 - [Tides and Water Levels](#)
 - Tides [Reading & Questions](#) & Tides in the Hudson [Student Activity](#)
-

Lesson 4: Testing the Salt Front- Students watch a video, then use Hudson River data to explore what biological indicators of the salt front might we rely on to find the salt front in the Hudson.

- Video: [Turbidity and Salinity of the Hudson River Estuary](#)
 - Testing the Salt Front [Student Activity](#) & [Teacher Section](#)
 - Extension: Finding the Salt Front [Student Activity](#) & [Teacher Section](#)
 - Extension: Data Visualization Hudson River Salinity [Teacher Section](#)
 - [Student 2008 Salinity Data](#) & [Student 2009 Salinity Data](#)
-

Lesson 5: Is the Hudson a River or an Estuary? - Students create models of a river and an estuary in a 3-part investigation looking at fish, salinity levels, and tides in the Hudson.

- Is the Hudson a River or an Estuary [Student Activity](#) & [Teacher Section](#)
 - [Part 1](#), [Part 2](#), & [Part 3](#) instructional PowerPoints
-

Lesson 6: Score one for the Estuary- Students apply problem solving skills to improve the environment of a local estuary, wetland, or waterway through participation in a stewardship project.

- Score one for the Estuary [Activity](#)
-

Teachers: Would you like to visit us at Norrie Point environmental education center, or have an educator visit your classroom in-person or virtually? Contact us to schedule a program: hrteach@dec.ny.gov

Resources:

Websites:

- [Hudson River Estuary Program](#)
 - [What is an Estuary \(NOAA\)](#)
-

- [LDEO Hudson River Educational Resources](#)
- [Estuaries \(NOAA\)](#)
- [Hudson River Estuary Program Lesson Plans](#)
- [Hudson River Park Science at Home](#)
- [Brooklyn Bridge Park Education](#)
- [Billion Oyster Project](#)
- [Hudson River Foundation Educational Resources Guide](#)
- [Hudson River Virtual River Series](#)
- [NYS Department of Environmental Conservation Education](#)
- [Voluntary Estuary Monitoring Manual](#)
- [Chesapeake Bay Foundation](#)
- [Hudson River Sloop Clearwater](#)
- [Watershed Map \(NYSDEC\)](#)
- [Exploring Our Fluid Earth – Teaching Science as Inquiry](#)
- [River of Words](#) - annual international poetry and art contest for K-12 students.
- Video: [History of the Hudson: Part I](#)

Books:

- [The Hudson: An Illustrated Guide to the Living River](#) by Stephen Stanne, Roger Panetta, Brian Forist & Maija Niemisto
- [The Hudson River Primer](#) by David Strayer