Estuaries

Topics: Hudson River Estuary

NEW YORK STATE | Department of Environmental Conservation

GRADE LEVEL: Middle 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 and salt water in the Hudson River.
- Analyze Hudson River data to identify tidal patterns and characteristics.
- 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.
- Create a model to explain how the moon impacts Earth's tides.

New York State Science Learning Standards:

MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects and the distance between them.
MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Key Understandings:

- 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.
- Ecosystems are dynamic in nature; their characteristics can vary over time.
- Earth and celestial phenomena can be described by principles of relative motion and perspective.
- Tides rise and fall daily in predictable patterns.

Essential Questions:

- What are the characteristics of estuaries that make them so important to living organisms?
- 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 and Harbor to understand how water flows through the Hudson River system?
- What is an estuary?
- What different types of water can be found in the Hudson River?
- How is the Hudson different from other rivers?
- What makes an estuary so unique?

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.
- 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.
- 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? Use informational surveys/questionnaires/inventories, K-W-L or I notice/I wonder to assess students' prior knowledge, have students write or draw in response to the essential questions. Ask students to draw/map the Hudson River and write down anything they feel like they don't know about the Hudson River.

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: Explore the Hudson River- Students watch a watching a video about the Hudson, read a short article about the Hudson River, and explore why estuaries are so important by researching an estuary reserve site.

- Video: Source to Sea
- From Mountains to the Sea - Reading
- Introduction to the Hudson: Journey down the river Student Activity
- Hudson River Estuary; Habitat; Navigation Puzzle Video
- Where Rivers Meet the Sea Video, Student Activity & Teacher Section
- Conservationist for Kids Magazine: Explore the Hudson River

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Lesson 2: Day in the Life of the Hudson and Harbor- 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
- Extension: Which Fish Where Student Activity & Teacher Section

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Lesson 3: The Hudson's Ups and Downs- Students watch a video then examine how tides change water levels along the Hudson River estuary. Students also explore how weather can affect water levels and tides.

- Video(s): Tide Finder & Measuring the Tide
- Tides Reading
- The Hudson's Ups and Downs Student Activity & Teacher Section
- Tides and Water Levels
- Extension: Introduction to Tides

Lesson 4: Finding the Salt Front- Students watch a video, then use Hudson River salinity data to find the location of the salt front and observe patterns of change in salinity along the estuary.

- Video: Turbidity and Salinity of the Hudson River Estuary
- Finding the Salt Front Student Activity & Teacher Section
- STEM Activity: Brackish Water Density & Spanish Version
- Extension: Data Visualization Hudson River Salinity Teacher Section
    - Student 2008 Salinity Data & Student 2009 Salinity Data

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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: Which Fish Where? - Students watch a video, then explore the relationship between salinity and fish distribution in the Hudson River.

- Video: Estuary Water Demonstration
- Student Fish and Salinity Worksheets
- Teacher Version
- Extension: Survival in an Estuary Activity

Optional Activities:

- **Score one for the Estuary-** students will apply problem solving skills to improve the environment of a local estuary, wetland, or waterway through participation in a stewardship project.
- **Estuarine Metaphors**- use common objects to suggest metaphors representing specific elements of the NY/NJ Harbor Estuary.

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
- Orange County Water Authority Education
- 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
- River by Elisha Cooper
- River Storytime: Video recording of the book River.