Across the Curriculum with Lighthouses

Lesson Creators: Betty Clarke, Lori Stapleton, Susan Stratton and Kathleen Stricker, Samsel Upper Elementary School, Sayreville

Grade level: 3-5

Timeframe: 4-5 class periods

Across the Curriculum Lessons about Lighthouses:

- **Language Arts**: Read *Beacons of Light Lighthouses* and write an informative paragraph
- **Geography**: Location of lighthouses in NJ
- **Math**: Observations of height, color, shape (geometry)
- **Science**: What is a Fresnel lens? How does an electric circuit work?
- **History**: Internet search and Timeline
- **Art**: Draw your own lighthouse or color a lighthouse (North American Lighthouses Coloring Book)
- **Civics**: Pennies for Preservation

Objectives:

Student will be able to explain why New Jersey has had so many lighthouses, the purpose of lighthouses and how the technology for ocean safety has changed.

New Jersey Student Learning Standards for Social Studies (2020):

6.1.5.CivicsPI.1: Describe ways in which people benefit from and are challenged by working together, including through government, workplaces, voluntary organizations, and families.

6.1.5.GeoPP.2: Describe how landforms, climate and weather, and availability of resources have impacted where and how people live and work in different regions of New Jersey and the United States.
6.1.5.GeoPP.3: Use geographic models to describe how human movement relates to the location of natural resources and sometimes results in conflict.

6.1.5.GeoHE.2: Cite examples of how technological advances have changed the environment in New Jersey and the United States (e.g., energy, transportation, communications).

6.1.5.GeoGI.1: Use multiple sources to evaluate the impact of the movement of people from place to place on individuals, communities, and regions.

6.1.5.GeoGI.2: Use historical maps to explain what led to the exploration of new water and land routes.

6.1.5.EconET.2: Use quantitative data to engage in cost benefit analyses of decisions that impact the individual and/or community.

6.1.5.EconET.3: Explain how scarcity and choice influence decisions made by individuals, communities, and nations.

6.1.5.EconNM.2: Use data to describe how the availability of resources in New Jersey and other regions in the United States have impacted economic opportunities.

6.1.5.EconNM.3: Describe how the development of different transportation systems impacted the economies of New Jersey and the United States.

**Common Core Science Standards:**

5.2 D Circuits: The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another.

**Common Core Math Standards:**

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form.

4.NBT.B.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm.

4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

4.G.A.2 Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.

4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

**Common Core ELA Standards:**

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

RI.4.5 Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.

RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.
SL.4.2 Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

SL.4.4 Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

W.4.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

Essential Questions

- What do lighthouses tell us about New Jersey’s geography and history?
- How has technology changed how lighthouses function?

Activities/Procedures:

1. **What is a lighthouse?**
   - Has anyone visited a lighthouse?
   - Where was the lighthouse?
   - Why are lighthouses located near the ocean?
   - What is their purpose?

   Lighthouses served two primary purposes. The first was illuminating waterways made treacherous by shoals, reefs, rocks and other hazards as ships left the open ocean and pulled into port. Most lighthouses also include fog signals such as horns, bells or cannons, which sound to warn ships of hazards during periods of low visibility. The second purpose is to serve as a reference to mariners. An individual lighthouse distinguished itself with its day mark -- the color schemes and patterns on the tower -- and its light signature. For example, a lighthouse might emit two flashes every three seconds to distinguish it from a lighthouse that emits four flashes every three seconds.

2. **Reading: Children’s Literature connections.**

   Student read *Beacons of Light: Lighthouses* (Gail Gibbons). The author illustrates four famous lighthouses, explains how lighthouses help locate danger areas for ships, then provides a historical background about beacons of light from bonfires at the tops of hills to the bonfires in stone towers. Have students write a paragraph summarizing the purpose and history of lighthouses.

3. **Geography and History: Where are our lighthouses? Why does New Jersey have so many lighthouses? When were our lighthouses built?**
   - Look at the map of lighthouses around New Jersey (Handout 1).
   - In groups, research the history of some or all of New Jersey’s lighthouses.
4. **Lighthouse Math**

- Using the chart on Handout 3, arrange the lighthouses in order of height, from the tallest to the shortest.
- Then, use their heights to calculate the number of steps in each lighthouse. (Hint: The Navesink Light has two towers. Do not forget to list both towers. Even though both towers have the same height, the North Tower has one more step.)
- Complete the chart and discuss: Why do lighthouses need to be so tall?

5. **History: Sandy Hook, New Jersey’s first lighthouse and the oldest lighthouse in continuous use the country**

Have students look at Handout 4: Sandy Hook Lighthouse and/or watch the video at http://www.youtube.com/watch?feature=player_embedded&v=c7TRiUhDdFg

**Background:** New Jersey is home to the oldest U.S. lighthouse (Sandy Hook) and several other very historic light stations (lighthouses are also referred to as “lights”). As early as 1679-80, Edmund Andreas, Colonial Governor of the Colony of New York, suggested to Sir George Carteret the advisability of constructing a lighthouse on Sandy Hook. However, no action was taken until 1761, when the project was revived by the merchant community of New York City, which has lost significant sums due to shipwrecks. The Provincial Council of the Colony of New York approved the purchase of land and the construction of a lighthouse from the proceeds of two lotteries. Sandy Hook Lighthouse was completed in 1764.

Sandy Hook Lighthouse was built of granite known as “rubblestone,” about 500 feet from the tip of the hook. Today, due to the northward expansion of the hook it now stands about 1 ½ miles from the point. The lamps installed in the crown were of copper encased in a lantern of ordinary glass. The keeper lived in a stone dwelling beside the tower. In order to pay for the upkeep of the lighthouse, a duty of three-pence per ton was imposed on shipping using the channel into New York Harbor.

In early 1776, the American colonists destroyed the light to avoid aiding the British fleet that was shortly expected to appear off New York City, prior to the invasion of the city. A British landing party relit the tower using improvised lamps and reflectors. On June 1, 1776, the Americans again tried to extinguish the light, this time using a pair of cannons mounted on several small boats. The Americans succeeded in damaging the tower somewhat before being driven off by an approaching armed vessel.

The Sandy Hook lighthouse became the first lighthouse in the country to be lit by electric incandescent lamps in 1889.
On June 11, 1964, Sandy Hook Lighthouse was declared an official National Historic Landmark, on the 200th anniversary of the date it began operation. The lighthouse and surrounding Fort Hancock are part of Gateway National Recreation Area today. The lighthouse is still in active operation. It is visible 19 miles at sea. In 1996, the ownership of the lighthouse was transferred from the Coast Guard to the National Park Service.

After reading about and/or hearing the history of Sandy Hook Lighthouse, have students answer the following questions:

- Why was Sandy Hook Lighthouse built?
- How was it maintained?
- Why was the lighthouse important during the American Revolution?
- Why is the Sandy Hook lighthouse now situated 500 feet from the tip of the hook?

6. Critical Thinking: Solve the Mystery of the Twin Lights

In the 1820s, because the volume of ships entering and departing the port of New York had become enormous, the federal government acquired just over two acres of land on the shores of the Navesink River for a new lighthouse. In 1828 the Federal Government built two identical, unconnected towers known as “twin lights.” But, after just 10 years, an 1838 report described the poor condition of the station: “the beams under the floors rotten; tower leaks in many placed; the light shows badly towards the north. Keeper's dwelling in good repair.”

By 1862, the lighthouses were in such a state of disrepair that the government decided to replace the structures with two new light towers connected by storage galleries and keepers quarters. The station became a showcase for the Lighthouse Establishment, where new navigational technology was tested before being employed in widespread use at other stations. Twin Lights became the initial first-order light to be fueled by mineral oil (kerosene) in 1883, and the first electrically powered lighthouse in 1898, when a huge bi-valve lens was installed in the south tower illuminated by an electric arc lamp. At that time, the south tower became the most powerful lighthouse in the country, producing a light of 25,000,000 candle-power that could be seen 22 miles at sea, though there were reports of it having been seen as far away as 70 miles when the light was reflected off a low-lying cloud bank. The light-station was used until it was decommissioned by the Coast Guard in 1949. Highly sophisticated aids to navigation, including the Ambrose Light-tower, made Twin Lights unnecessary. The huge bivalve lens was acquired by the Boston Museum of Science and Technology from the Coast Guard in 1951, and placed on exhibit there.

In 1960, the facility became a New Jersey State Historic site. In 1979, through the efforts of the Twin Lights Historical Society, Rumson Garden Club, and NJ Division of Parks and Forestry, the Fresnel lens was returned home to Twin Lights. Today, the museum features well-interpreted exhibits of lighthouse, Life-Saving Service and other memorabilia. For more information go to https://www.twinlightslighthouse.org/

The location of the initial twin lights had been lost. Their location and why they fell into disrepair so quickly were mysteries to be solved by archeological excavation. Can you help solve the mystery?
Have students look at Handout 5: Twin Lights on the Navesink River

**The mystery solved:** The original Twin Lights were built of rubble and with beach sand used as mortar to hold it together. The salt in beach sand leads to rapid mortar failure, causing the structure to quickly fall apart. A team of archeologists and students from Monmouth University discovered this when excavating for the original twin lights. (See *Digging New Jersey’s Past: Historical Archeology in the Garden State* by Rich Veit (2002).

7. **Science: How do the lights in lighthouses work?**

Early lighthouses were lit by candles, coal fires, and oil lamps, then coal and gas. Over the years, the lighting of lighthouses has been improved by improved technology.

**The Fresnel Lens**

The French inventor, Augustin-Jean Fresnel, developed a lens that could better focus a light beam. The “Fresnel” lens was first used in a lighthouse in France in 1823. Fresnel died in 1827 at age 39 after a lifelong battle with tuberculosis.

The Fresnel lens can capture more oblique light from a light source, thus allowing the light from a lighthouse equipped with one to be visible over greater distances. Imagine taking a plastic magnifying glass lens and slicing it into a hundred concentric rings (like the rings of a tree). Each ring is slightly thinner than the next and focuses the light toward the center. Now take each ring, modify it so that it's flat on one side, and make it the same thickness as the others. To retain the rings' ability to focus the light toward the center, the angle of each ring's angled face will be different. Now if you stack all the rings back together, you have a Fresnel lens. Large Fresnel lenses are often used as solar concentrators.

- Have students look at Handout 6 and explain how a Fresnel light works.
- A Fresnel lens was installed in Sandy Hook Lighthouse in 1857. The light at Sandy Hook Lighthouse throws a light 12 miles out to sea. Not all lighthouses have Fresnel lenses.
- Nearly all lighthouses in National Park units originally had a Fresnel lens. According to the U.S. Lighthouse Society, more than 75 Fresnel lenses are still in use in lighthouses in the United States.

**The electric incandescent light**

Then Thomas Edison invented the electric lightbulb, working in Menlo Park, New Jersey (see Innovations from New Jersey lesson). Sandy Hook Lighthouse became the first lighthouse in the country lit by electric incandescent lamps in 1889, and that is what runs most lighthouses today.

The lighthouses offer an opportunity for students to learn how an electrical circuit works.

Electricity follows a closed path called a circuit. The electricity flows around and around. Circuits need something to act as the source of electricity. When you put a battery in the circuit, electricity can flow. There is usually a switch in the circuit that lets you stop the flow of electricity when
needed. When the circuit is closed, electricity will flow all through the circuit. When the switch is open, you create a hole in the circuit, and the flow of electricity stops.

- Students read “What is an Electrical Circuit” (Handout 7) and answer the true/false questions and label the parts of the closed circuit.

What other technology do we have today to avoid shipwrecks? Radar, sonar, two-way radios, and emergency locators. But the lights from lighthouses are still used and helpful.

8. Art (and maybe even some Math): Create your own lighthouse

Have students construct models of lighthouses from paper, using math skills to measure the angles. Alternatively, have students draw a lighthouse or color a lighthouse (*North American Lighthouses Coloring Book*)

Assessment

Students write a short essay explaining what lighthouses tell us about New Jersey’s geography and history and how technology has changed the function of preventing shipwrecks.

Extension

1. Civics (and phys ed!): Take the Lighthouse Challenge.

The “Lighthouse Challenge of New Jersey” is an annual event that takes place the third weekend of October. The challenge is to visit 10 land-based lighthouses, 3 lifesaving stations, 1 museum, and 1 virtual site over the two-day weekend. The challenge route covers the Atlantic Coast from Sandy Hook to Cape May and the Delaware Bay and River Coast from Cape May to Paulsboro. The Lighthouse Challenge raises needed funds for the continued preservation of lighthouse and other landmarks. Go to [https://www.lighthousechallengenj.com/](https://www.lighthousechallengenj.com/)
2. **History: The Statue of Liberty was a lighthouse?**

A gift of friendship from the people of France to the United States and is recognized as a universal symbol of freedom and democracy, the Statue of Liberty was dedicated on October 28, 1886. Everyone is familiar with the Statue of Liberty as a symbol of the promise of America, but few are probably aware that, for a few years early in its existence, it was also officially a lighthouse operated under the authority of the Lighthouse Board. The lighted torch in Lady Liberty’s right hand had, and still has, great symbolic significance, but at its beginning, it was also used as a navigational aid for ships entering New York Harbor. In 1886, President Grover Cleveland ordered that the Statue of Liberty be “henceforth maintained, lighted and tended in accordance with such rules and regulations as now exist” under the Lighthouse Board. The Lighthouse Board experimented with electric arc lamps placed in the torch of the Statue of Liberty, which was used briefly during this time as an aid to navigation.

Have students look at Handout 8 of the Statue of Liberty to consider it as a lighthouse and find out more about the Statue of Liberty as a lighthouse by going to [http://www.lighthousefriends.com/light.asp?id=581](http://www.lighthousefriends.com/light.asp?id=581)

3. **Invite a speaker** from the NJ Lighthouse Historical Society to speak to visit your school and speak with your students about our state’s lighthouses.

4. **Field trip.** Visit a Lighthouse near you. Those open to the public include the following (click on them for more information):

1. [Barnegat Lighthouse](#)
2. [Cape May Lighthouse](#)
3. [East Point Lighthouse](#)
4. [Finn’s Point Range Light](#)
5. [Hereford Inlet Lighthouse](#)
6. [Tucker’s Island Lighthouse (Replica)](#)
7. [Navesink Twin Lights](#)
8. [Sandy Hook Lighthouse](#)
9. [Sea Girt Lighthouse](#)
10. [Statue of Liberty](#)
11. [Tinicum Island Range Light](#)
Handout 1

New Jersey Lighthouse Map

1. Sandy Hook Lighthouse
2. Twin Lights of Navesink
3. Sea Girt Lighthouse
4. Barnegat Lighthouse
5. Absecon Lighthouse
6. Hereford Inlet Lighthouse
7. Cape May Lighthouse
8. Brandywine Shoal Lighthouse
9. Miah Maull Lighthouse
10. East Point Lighthouse
11. Cross Ledge Lighthouse
12. Elbow of Cross Ledge Lighthouse
13. Ship John Shoal Lighthouse
14. Finns Point Range Light
15. Tinicum Range Light
16. Ambrose Light Tower
New Jersey’s Lighthouses

<table>
<thead>
<tr>
<th>Year</th>
<th>1820</th>
<th>1830</th>
<th>1840</th>
<th>1850</th>
<th>1860</th>
<th>1870</th>
<th>1880</th>
<th>1890</th>
<th>1900</th>
</tr>
</thead>
</table>
New Jersey's Lighthouses

Use the data below to complete this assignment. First, arrange the lighthouses in order of height, from the tallest to the shortest. Next, use their heights to calculate the number of steps in each lighthouse. (Hint: The Navesink Light has two towers. Do not forget to list both towers. Even though both towers have the same height, the North Tower has one more step.)

**Lighthouse Names and Heights**

<table>
<thead>
<tr>
<th>Lighthouse Name</th>
<th>Height in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereford Inlet 57 ft.</td>
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<tr>
<td>Finn's Pt. Rear Range 115 ft.</td>
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<tr>
<td>Point 40 ft.</td>
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<tr>
<td>Absecon 169 ft.</td>
<td></td>
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<tr>
<td>Tincum Rear Range 112ft. East</td>
<td></td>
</tr>
<tr>
<td>Cape May 157 ft.</td>
<td></td>
</tr>
<tr>
<td>Sandy Hook 85 ft.</td>
<td></td>
</tr>
<tr>
<td>Barnegat 165 ft. Sea</td>
<td></td>
</tr>
<tr>
<td>Girt 44 ft.</td>
<td></td>
</tr>
</tbody>
</table>

**Number of Steps**

<table>
<thead>
<tr>
<th>Lighthouse Name</th>
<th>Height in Feet</th>
<th>Number of Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navesink Twin Lights North Tower 73 ft.</td>
<td></td>
<td>217 steps</td>
</tr>
<tr>
<td>Navesink Twin Lights South Tower 73 ft.</td>
<td></td>
<td>112 steps</td>
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<td></td>
<td></td>
<td>65 steps</td>
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<td></td>
<td></td>
<td>119 steps</td>
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<td>45 steps</td>
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<td>51 steps</td>
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<td>64 steps</td>
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</table>

**Lighthouse Name**

<table>
<thead>
<tr>
<th>Number of Steps</th>
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<tbody>
<tr>
<td>217 steps</td>
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<td>51 steps</td>
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<tr>
<td>64 steps</td>
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</tbody>
</table>
If all of the lighthouses were placed one on top of each other, how many feet high would they be?

If you climbed to the top of all of these lighthouses, how many steps would you have climbed?
Sandy Hook Lighthouse
Fresnel Lens

Fresnel lens on display at Point Arena Lighthouse Museum, Mendocino, CA

Fresnel Lens in a lighthouse
What is an Electric Circuit?

Electricity follows a closed path called a circuit. The electricity flows around and around. Circuits need something to act as the source of electricity. When you put a battery in the circuit, electricity can flow. There is usually a switch in the circuit that lets you stop the flow of electricity when needed. When the circuit is closed, electricity will flow all through the circuit. When the switch is open, you create a hole in the circuit, and the flow of electricity stops.

Read each statement: Write “T” if the statement is true or “F” if it is false.

1. ______ In order for electricity to work, it must be able to leave a battery and return to a battery.

2. ______ The path electricity takes is called a circuit.

3. ______ If a switch is open, it is a closed circuit.

4. ______ Batteries can supply the source of electricity in a circuit.

5. ______ Electricity does not flow in a closed circuit.
6. _____ Wires are used to connect the parts of a circuit together.

7. Label the following parts of the closed circuit on the lines provided:

Battery        Switch        Light bulb
Handout 8

Find out more about the Statute of Liberty as a lighthouse by going to http://www.lighthousefriends.com/light.asp?ID=581