

**TEACHER'S
LIGHTHOUSE
RESOURCE
FOR
GRADES K-4**

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THE U.S. LIGHTHOUSE SOCIETY ORIGINALLY DESIGNED THIS PACKET TO FURNISH TEACHERS WITH BASIC INFORMATION ABOUT LIGHTHOUSES, THEIR PURPOSE, HISTORY, OPERATION AND TECHNOLOGY IN A FORM PRESENTABLE TO YOUNG STUDENTS. WITH THE SOCIETY'S PERMISSION THE U.S. COAST GUARD HISTORIAN'S OFFICE IS POSTING THIS MODIFIED VERSION WITH ADDITIONAL PHOTOGRAPHS AND INFORMATION.

THE U.S. COAST GUARD HISTORIAN'S OFFICE WOULD LIKE TO THANK MR. WAYNE WHEELER AND THE OTHER MEMBERS OF THE U.S. LIGHTHOUSE SOCIETY WHO PRODUCED AND DISTRIBUTED THE ORIGINAL VERSION OF THIS CURRICULUM.

THE SUGGESTED ACTIVITIES RELATE TO VARIOUS DISCIPLINES - ART, SCIENCE, LANGUAGE ARTS, MATH, HISTORY AND GEOGRAPHY.

THE TEACHER MUST CHOOSE WHICH MATERIAL IS APPROPRIATE FOR THE GRADE LEVEL BEING TAUGHT. FOR MORE INFORMATION ON LIGHTHOUSES, TEACHERS AND STUDENTS SHOULD CONTACT THE U.S. LIGHTHOUSE SOCIETY, 244 KEARNY STREET, SAN FRANCISCO, CA

94108 OR CONSULT THE LIGHTHOUSE WEB PAGES ON THE U.S. COAST GUARD HISTORIAN'S WEB SITE.

GOALS

1. To familiarize children with lighthouses as aids to navigation.
2. To have students gain a basic understanding of lighthouse operation and the evolution of lighthouse technology.
3. To make children aware of the historic role of lighthouses and their current status.
4. To teach children the properties of light and how these are employed to enhance the effectiveness of the light signal.

The Story of the Lighthouse

Many, many years ago (thousands of years to be more exact), people lived in a very primitive way--both hunting for and growing their own food (there were no supermarkets in those days, no stores at all!). Eventually they decided to explore the water in a boat to find out what the sea had to offer in the way of food. And, what did they find? They found fish and all kinds of other seafood: clams, mussels, scallops, oysters, lobsters, crabs, etc. During the day they could find their way back to the landing place by looking for a pile of rocks that had been left there.

These daymarks were the first aids to navigation. But how could they find their way home at night? Since much of the shoreline looked very similar, friends had to light a bonfire on a high point to guide them to the right landing area. Still later they used a pole or a tripod to hang a METAL basket containing a fire as a method of signaling (a lever light).

Our first lighthouses were actually given to us by Nature. Sailors sometimes used landmarks such as glowing volcanoes to guide them. In the Ancient World, trading ships were eventually built enabling navigators to sail long distances to buy and sell goods. In the days of wooden ships with sails, the wind and waves could easily push them against the rocks and wreck them. And so, the need for lighthouses as warning signals arose.

One of the Seven Wonders of the Ancient World was a lighthouse--the famous Pharos of Alexandria, Egypt. It is the first one that is recorded in history and was built about 280 BC. Those records tell us that it was the tallest one ever built -- 450 ft. (comparable to a 45-story skyscraper) and used an open fire at the top as a source of light. (Can you imagine being the keeper, climbing to the top to light the fire, and then forgetting the matches or whatever was used in those days to start a fire?)



Pharos-The First Lighthouse

This fantastic structure survived for 1500 years until it was completely destroyed by an earthquake in the 14th Century. Slave labor was used to build it, and it took twenty long years to complete. It was a three-part tower--with a square base, a second story with eight sides and a narrow, taller, round third story. At night they believe its lighted fire could be seen for thirty miles, whereas by day it produced a column of smoke for a daymark. Today we call people who study (or are interested in) lighthouses pharologists. The name comes from that famous lighthouse.

What is a lighthouse?

It is a tower with a bright light at the top, located at an important or dangerous place regarding navigation (travel over water). The two main purposes of a lighthouse are to serve as a navigational aid and to warn boats of dangerous areas. It is like a traffic sign on the sea. What a seeing-eye dog is to a blind person is what a lighthouse is to a seaman.

Do all lighthouses look alike?

Although we often think of a lighthouse as a tall, white conical tower, there are many, many variations of design. Depending on its location, it might be tall (where the land was very flat) or short and squat (where there was a high cliff or rocky coast). It could be square, octagonal (with eight sides), conical (like an ice cream cone upside down), cylindrical (like a very fat pipe), or even like a skeleton.



(L to R) Tall, conical light (Pensacola, FL); Screwpile light (Thomas Point, MD); Round caisson/sparkplug light (Duxbury, MA)

Lighthouse also come in different shapes and sizes...



(L to R) Octagonal (8 sides) (Sandy Hook, NJ); Cylindrical (Point Arena, CA); Skeletal (Boca Grande, FL); Conical (Currituck, NC)



Square
Big Bay, MI

You might find the lighthouse standing alone, attached to the building where the lighthouse keeper lives, or connected to the keeper's quarters by an enclosed walkway. Sometimes the lantern room is built into the roof of the keeper's house.

When the lighthouses were built, they were constructed with whatever materials were most readily available. They were designed to fit the local geographic and climatic conditions. Some are made of stone; others brick, concrete, wood, steel, cast iron, and even tabby (a mixture of shells, lime, sand and water). So you can see that each lighthouse is very unique.

Where are lighthouses located?

They can be found in a variety of places, on rocky cliffs or sandy shoals on land, on a waveswept reef in the sea, and at entrances to harbors and bays. They serve to warn the sailor of dangerous reefs beneath the sea or perilous rocky coasts on land, and to guide ships into a safe harbor or back out to sea. So the message of the lighthouse might be --STAY AWAY, DANGER, BEWARE, or COME THIS WAY. Every lighthouse tells the mariner, "This is exactly where you are."



(L to R) Tillamook Rock, OR; Fire Island, NY; Minot's Ledge, MA; Cleveland, OH

Our country has several coastlines used by ships from around the world. In the East it borders the Atlantic Ocean, in the West the Pacific Ocean, and in the South the Gulf of Mexico. But we also have another very important area of coastline where the land meets the sea, the Great Lakes. So, all of these four areas bordering our country need and have lighthouses, as well as some of our more important navigable inland waterways. For example, the Hudson River, Lake Champlain, Chesapeake Bay and San Francisco Bay are also dotted with lighthouses.



(L to R) Saugerties, NY; Crown Point, NY; Drum Point, MD; Alcatraz, CA

How could one lighthouse be distinguished from another?

Years ago, before they had all the sophisticated technology of today-- LORAN, radar, sonar, on ship electronics, radio beacons, etc.--ships near shore in the daytime would use lighthouses as a landmark. This use gave them an additional name--a DAYMARK.

Imagine that you are the Captain of a ship sailing along the coast. You need some landmarks to help you find your position. When you look on shore you see a tall red brick tower. Then you sail about forty miles down the coast and you see another round red brick tower--just like the first one. How would you know where you are? This is the way things were along a portion of the Virginia and North Carolina coast in the 1870's. To help the mariner determine his location the Lighthouse Board (which was in charge of lighthouses from 1852-1910) issued an order to have each lighthouse painted in different colors and/or designs. This is the best example of DAYMARKS we can see today.



(L to R) Cape Henry, VA; Bodie Island, NC; Cape Hatteras, NC; Cape Lookout, NC

Cape Henry Virginia (the tallest cast-iron lighthouse in the U.S. today) was painted in alternating black and white sections. Bodie Island was painted with horizontal bands. Cape Hatteras (the tallest one in the country) was

given spiral bands. Cape Lookout was painted in a diamond or checkerboard pattern. On some lighthouses elsewhere the color red has been used to help distinguish them. There are two very striking ones painted in red stripes--at West Quoddy, Maine, and Assateague, Virginia



(Left) West Quoddy Head, ME; (Right) Assateague, VA

But, what about nighttime--the most dangerous time to navigate, and the main reason lighthouses exist? You can't see colors or patterns at night, but you can see lights. However, unless there was some way to make each light different you could have the same problem. Early on, in a few places in our country, they built multiple lights (that is, two or three together.) There are twin lights at Cape Elizabeth, Maine and at Thatcher Island, Massachusetts that are still visible today.



(Left) Cape Elizabeth, ME; (Right) Thatcher Island, MA

On Cape Cod, they built three lights which they call "The Three Sisters of Nauset", no longer in use, but which have been moved to a central location

and preserved by the National Park Service for us to see today. Many of the double lights were either torn down or one of the twins was moved to another location. Building double or triple lighthouses was one way to help the sailors at sea determine their location, but it was a very expensive way to do it.



"Three Sisters" on Nauset Beach, MA

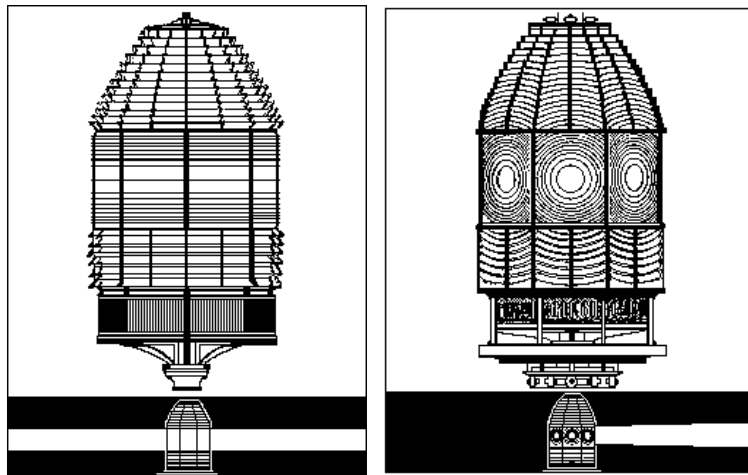
Mounting a group of lights on a rotating framework made it possible to produce a special signature (the first flashing characteristic) for each lighthouse, so they could be easily told apart (more on this follows). A group of lights mounted on a rotating frame made a lighthouse look like it was flashing its light on and off.

The invention of the Fresnel (pronounced "Frey Nel") lens in 1822 was probably the most important discovery in lighting technology. As well as enabling man to produce an unlimited number of flashing combinations, it also intensified (brightened) the light so it was much more helpful to the mariner, and could be seen at greater distances.

The Fresnel lens can be compared to a huge lampshade except that it is made of 100's of pieces of beautiful, specially cut glass. It surrounds the lamp bulb, but differs from a lampshade, which concentrates the light downward. This lens, due to its special design, and because it is made of glass, intensifies (brightens) the glow from the light. It takes the rays of light which normally scatter in all directions and bends (refracts and reflects) them, focusing them into a single beam of light, which shines out in a specific direction.

Fresnel lenses are of two types: Fixed--which shows a steady light all around the horizon and Revolving--which produces a flash or a characteristic. The

number of flashes per minute depends on the number of flash panels and the speed at which the optic (lens) revolves. (Teacher: See footnote.)



(Left) Fixed Fresnel Lens; (Right) Rotating Fresnel Lens

Different periods of darkness and light produce a unique flash pattern for each light. For example, a light can send out a flash every five seconds, or it might have a fifteen-second period of darkness and a three-second period of brightness, or any number of other combinations. The individual flashing pattern of each light is called its *CHARACTERISTIC*. Mariners have to look at a light list or a maritime chart that tells what light flashes that particular pattern and what color the light is as well. Then they are able to determine their position at sea in relation to the land.

***Note:** There was actually one more style for clarification. So as not to confuse young students I elected to leave this off. It is a fixed light varied with flash. However, if your students are particularly precocious, you may elect to use it.

Today aerobeacons are also used to help identify each lighthouse. They, along with the Fresnel lens, are the principle behind the automobile headlight.

Fresnel lenses come in seven commonly used sizes (called orders). The larger ones (1st order), used on major seacoasts, flash a more powerful beam which shines as far as twenty-one miles out to sea. Sixth order lights, the smaller ones, are used in bays where they do not have to shine as far or as brightly.

Most look like a beehive or barrel; some have bullseyes and can contain from two to twenty-four different panels. Those with the fewest flash panels (two) are called clamshell or bivalve lens. A clockwork type mechanism (which had to be wound by hand every few hours before the advent of electricity) is used to make these revolving lenses rotate around the lamp itself to produce the flash. The movement of the lens is timed precisely so the bullseye panel will pass by when a flash is due.

These lenses are really beautiful works of art; most contain hundreds of prisms -- pieces of specially ground, cut and polished glass which, when arranged in a certain way, bend (reflect and refract) the light. Thus all the rays of the light are collected and redirected into a single beam of light. This makes it much brighter and more effective. The lenses themselves can weigh as much as four tons.

There is one light near Boston (Minot's Ledge on the killer reef) which flashes out a characteristic of one flash, darkness, then flash, flash, flash, flash, darkness, then flash, flash, flash, or 1-4-3. The people nearby call it the "I Love You" light because it flashes out the number of letters in each of those words.

Another way to distinguish lights is through the use of color. Although most lights have a white lamp, some do use red and others green lights, as well as combinations of the colors.

What happens in fog when the light isn't visible? Have you ever been out in a car on a dark, stormy, very foggy night? You know how difficult it is to see other cars on the road. Now, picture yourself sailing along a black-looking sea in a thick pea soup fog with no stars shining or moonlight visible. The windshield wipers are working overtime, but the fog blocks the view of the light. In situations like this there is another method of notifying the mariner, using sound. It is called a foghorn. The first one was used in 1719 at Boston light and it was, of all things, a cannon. Can you imagine being a lighthouse keeper and having to fire the canon every hour when there was fog? During a long spell of fog you wouldn't get any sleep. Later they tried various other means of making a noise for warning. Fog bells were used as well as steam whistles and reed trumpets and sirens. The sounds they gave out were generally low-pitched and very mournful--almost like a wail. Each one emitted a specific number of blasts every minute so it could be told

apart from all others. Today, an automatic sensor, which detects moisture in the air, turns on the fog signals when needed. There are also soundless fog signals called radio beacons (an electronic device).

These fog signals were not placed everywhere. Although some places experience no fog problems, fog-warning devices are very necessary in New England, on the Pacific Coast, and in Alaska

What fuels produced light?

The main source of power for the light today is electricity, although in some places they use acetylene gas. For thousands of years before Thomas Edison invented the electric lamp (bulb) in 1879, different fuels were used to illuminate the lamps. First, it was wood and coal for fires, then bales of oakum and pitch, and rows of candles. Later lamps were lit using various fuels --sperm whale oil (produced by cooking the blubber of the whale), lard oil (from animal fat), kerosene (a fuel like gasoline with a petroleum base), etc.

When they first designed a lighthouse with an enclosed lantern room (the original 1696 Eddystone Light in England) it was possible to employ candles for light. This wave-swept lighthouse used 60 candles! Most used far fewer candles that were sometimes arranged in a circular candelabra or a chandelier with two tiers, or on a frame.

Next came spider lamps that consisted of a shallow brass pan containing oil with either four, eight or more wicks usually arranged in a circle, but other shapes such as a rectangle were also used. (Since a spider has eight legs, the first one probably had eight wicks!)

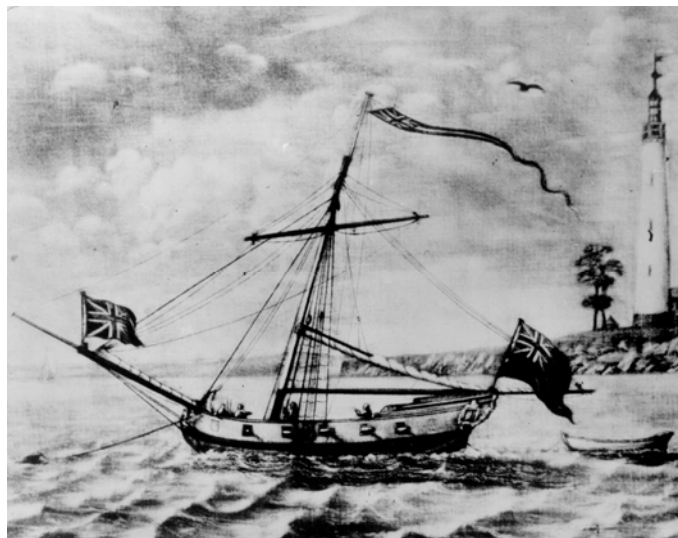
Two very important discoveries occurred in the late 1700's. The parabolic reflector was a bowl-like device with a small oil lamp in the center. The light from the lamp was gathered and focused into a beam. This was similar to putting a mirror behind a flame. Thus the first really efficient lighthouse was created. Think of a flashlight that has a silver reflector behind the tiny bulb to increase the brightness of the light. It is based on the same principle.

The invention of the hollow wick oil lamp (the Argand lamp) resulted in a light that was seven times brighter than a candle. This lamp was used with various types of fuel inside the Fresnel lens until the electric light bulb was invented.

The first lighthouse ever to use electricity in this country was the Statue of Liberty in 1886. Yes, this special symbol of freedom was used as a lighthouse in New York harbor for the first fifteen years of her existence.

When were the first lighthouses built in the U.S.?

In colonial times, before we became an independent nation, men realized the need for lighthouses at the major ports to help guide ships into the harbors, to prevent them from crashing, and thereby losing their precious cargoes. So, the first lighthouses were built by the colonies (which were called states after 1776).



First Boston Light

In those days the ship owners had to pay a fee (toll) for the use of the lights which helped cover the costs of their construction and maintenance. Each ship that passed by a lighthouse on its way into or out of a port paid a

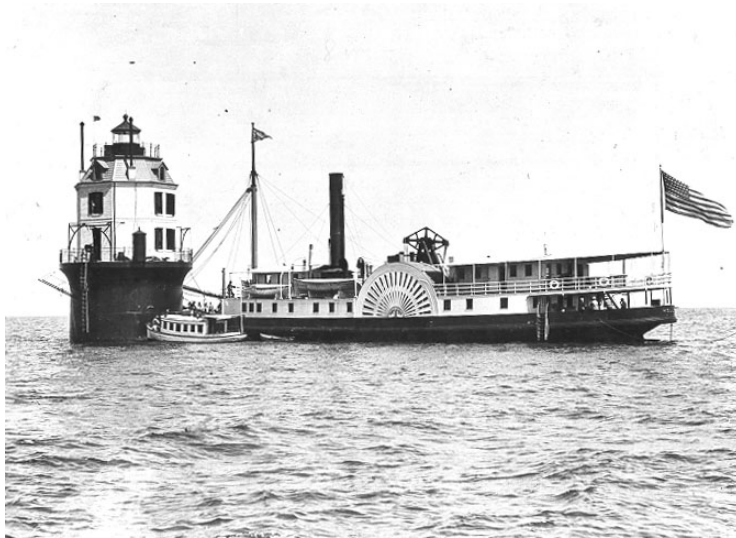
tax based on the weight of the cargo it was carrying. They paid a penny for each ton of goods on board ship. (You have to remember that in those days a penny was worth a lot more than it is today.) Once we gained our independence from Great Britain and the federal government took charge in 1789, this fee was eliminated.

Most lighthouses were named for their location, but several were named after ships that wrecked themselves nearby before a lighthouse was built. For example: Carysfort, Fowey, Alligator Reefs, Pigeon Point and Ship John Shoal. Others were named because of events which occurred there: Cattle Point, Dead Man's Rock, Cape Disappointment, Destruction Island, and Execution Rocks.

What is the difference between a lighthouse and a light station?

A lighthouse is the tower itself containing the lantern room with the lens that shines its light. A light station (which is usually onshore, but occasionally on offshore islands) is the property containing multiple outbuildings of the "station", as well as the lighthouse tower itself. There were usually separate living quarters (houses), depending on the number of lighthouse keepers and assistants living there. Besides these there would probably be an oil (or fuel) house, a barn, a boathouse, and a fog-signaling building.

Lights with no families living in them, (called "stag lights" in some areas) were usually located on offshore islands or reefs, and inhabited by men only. Their quarters for sleeping, eating, and recreation were located on the various levels of the lighthouse itself. One room was located above the other and a winding staircase connected them. It was pretty confining to have to live in that one building, especially in the days before the invention of the telephone, radio and TV.



Tenders re-supplying lighthouses

They had to stay on the island for a certain period of time before a tender (small boat) came out with supplies and other keepers to relieve them of duty and give them some shore leave. If the weather was too rough for the boat to come out, often they had to stay many extra days or weeks before being taken to shore. In later years helicopters were sometimes used for transportation.

What were the duties of the lighthouse keepers?

Before the days of electricity, they had to light the lamp at sunset and extinguish it (put it out) at sunrise. During an 8-hour watch at night they had to climb the stairs in the tower one to three times a night to check on the lamp and wind the weights. Some lighthouses have as many as two hundred steps! They earned the name "wickie" because one of the chores was to trim the burned lamp wick, so it wouldn't smoke and dirty the lens. The brass in the building had to be shined, and all the windows cleaned. Often it took a whole day to clean and polish the lens alone. It was very important to keep both the lens and the lantern room windows clean so the light would not be lessened in any way.



Keeper and his family during the 1800's



Working on the fog signal Inspecting the Lens

A daily log had to be kept detailing everything from the weather to the amount of fuel consumed. The Keeper also had to tend to the mechanism used to operate the fog signal. During the year many items had to be painted. So the Keeper and his family were kept very busy.

What part of the government controlled lighthouses?

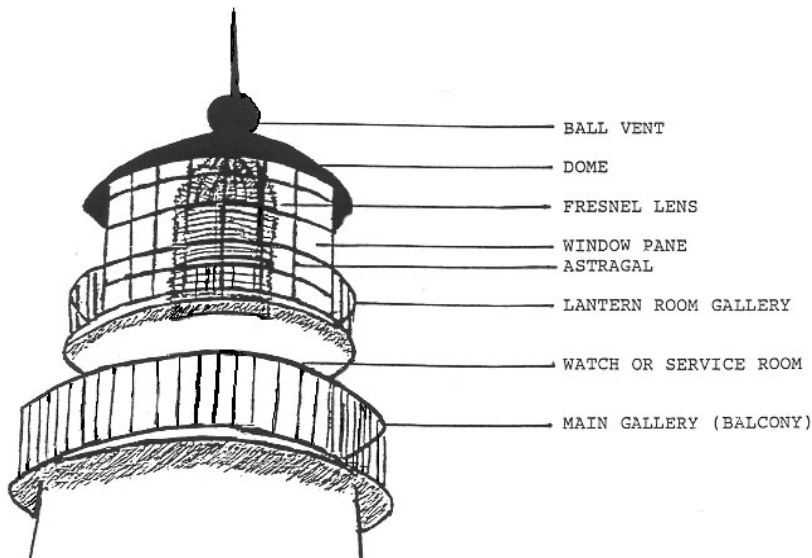
One of the first acts of the federal government provided for aids to navigation. On 7 August 1789 the First Congress federalized the colonial lighthouses. This was the beginning of the U.S. Lighthouse Service. Congress also appropriated funds for lighthouses, beacons, and buoys. For the first five decades, however, there was little bureaucratic support for the service. Worse, there were no tenders to re-supply the keepers. Only the lone keepers' sense of duty kept the lights burning.

The men and women of the Lighthouse Service were among the most dedicated civil servants, often performing in extreme hardship. Abbie Burgess, while also caring for her family, served 38 years at the Matinicus Rock and White Head Light Stations in Maine. Keepers also saved lives. Ida Lewis rescued 18 people during her 39 years at the Lime Rock Lighthouse and Marcus Hanna, the keeper of the Cape Elizabeth Light, is the only man to have won the Medal of Honor and the Gold Lifesaving Medal. Other keepers died on duty. A 1906 hurricane, for instance, destroyed twenty-three lights along the Gulf Coast and killed the keepers at Horn Island and Sand Island. In 1946 a tsunami destroyed the Scotch Cap (Alaska) light and killed the entire crew.

Lighthouse administration bounced between the Treasury Department and the Commerce Department until President Franklin Roosevelt combined the Lighthouse Service with the Coast Guard in 1939. Since that time increased mechanization and improved technology have made keepers unnecessary. Lighthouses are now fully automated and many have automatic bulb changers

to ensure that the lights do not go out. The only remaining station with a keeper is that in Boston Harbor. Despite the fact that Coast Guard people are no longer stationed at most of the lights, the legacy of the keepers and the U.S. Lighthouse Service remain a vital part of the U.S. Coast Guard's heritage.

What is the most important aspect of the lighthouse?



Of course it is the light that shines out from the lantern room at the top which encloses and protects the lens. This lantern room is made of METAL and glass that is divided into sections by pieces called astragals. Usually they are vertical (up and down), but some are diagonal.



(Left) Vertical astragals; (Right) Diagonal astragals

In this world, at every period in history, there have always been some people who did not want to work for a living, and tried to live off the sweat and toil of other people. During the last century there were men along certain of our Eastern shores who would lure ships to an isolated beach by shining lights to make the sailors think it was a safe harbor. When the ship ran aground and the cargo washed ashore, they stole it and sold the goods. They were called "mooncussers" because they operated on nights when the moon was not shining. Another name for them was "wreckers."

The false lights were called "Judas lights." At one place in North Carolina, they tied a lantern around a horse's neck and walked him back and forth along the beach to lure ships in to their destruction. That is how the place called "Nag's Head" got its name.

What is happening to lighthouses at present?

Today, all of the lighthouses in our country have been automated, except the one at Boston, which still has keepers, for sentimental reasons only. (Boston Light was the first one built on our shores.)



Present Boston Light

Many of the lighthouses are no longer needed due to advances in technology and they have been or are being turned over to various government agencies or non-profit local organizations to maintain and administer. It is important to keep them in good condition for future generations to learn about their place in the maritime history of our country. It is also a special experience to be able to climb the stairs just as the keepers did and picture what life was like in times past. They also need protection from vandalism and threats of erosion.

LIGHTHOUSE FACTS

* The first known lighthouse was the Pharos of Alexandria, Egypt. Constructed between 300 and 280 BC by Ptolemy I and his son Ptolemy II, it stood about 450 feet high. This lighthouse was one of the Seven Wonders of

the Ancient World. It was destroyed in stages by invaders and earthquakes, being completely destroyed in the 1300's.

*The oldest existing lighthouse in the world is considered to be La Coruna in Spain that dates from ca. 20 BC. A Roman lighthouse is located on the Cliffs of Dover in Britain that was constructed in 40 AD.

*The first lighthouse in America was at Boston on Little Brewster Island (1716). The first keeper was George Worthyake who drowned, along with his wife and daughter, when returning to the island in 1718. The original tower was destroyed by the British and eventually reconstructed in 1784.

*The oldest existing lighthouse in America is Sandy Hook, NJ (1764) which is still in operation.

*There were 12 lighthouses when the United States declared its independence in 1776.

*The tallest lighthouse is Cape Hatteras, NC (196 ft. built in 1872).

*The most expensive lighthouse built in America is St. George Reef, off Crescent City, CA. It took ten years to construct (1882-1892) and cost \$715,000.00. The Coast Guard abandoned it in 1972.

*The Lighthouse Service was created in 1789 by the 9th Act of the first Congress. Over the years, lighthouses were placed under the direction of Department of Revenue (this department was disbanded in 1820), Treasury (until 1903), the Commerce and Transportation. The Lighthouse Board (of the U. S. Lighthouse Establishment) held sway from 1852 to July 1, 1910 when Commerce created the Bureau of Lighthouses. The Coast Guard took over on July 7, 1939.

*After 1852 the country was divided into Districts; originally eight, they eventually numbered 19. Today the Coast Guard only has ten districts. The USLHE had a District Inspector (Naval Officer) as operational control. He ran the district in tandem with an Army Corps of Engineer who was in charge of engineering projects. In 1910 civilians started replacing the military officers.

*There were never more than 850 lighthouses in operation at once, although about 1,500 were constructed in this country over the years. The hey-day was around 1910. There were 220 constructed on the U.S. shores of the Great Lakes. Michigan had the most with ca. 90 followed by Maine with about 80.

*Lightships were employed where the water was too deep to construct a lighthouse or it was impractical. The first lightships were located in the lower Chesapeake Bay (1820) and the most stations were in 1915 when there were 72 lightships manning 55 stations. The extra ships were used for relief. Lightships displayed lights at the tops of their mast(s) and in foggy areas sounded a bell or other fog signal such as a whistle, siren or horn. In 1921, lightships began being equipped with radio beacons. The last lightship was removed from the Nantucket Station in 1984.

* The first fog signal in this country, a cannon, was at the Boston Lighthouse. Other fog signals have been whistles, sirens, reed trumpets, bells, diaphone (BEEEEoooooh) horns and diaphragm (brrrrrrrrrr) horns.

*Whale oil was used with solid wicks as the source of light until a parabolic reflector system was introduced around 1810. Although the Fresnel lens was invented in 1822, it was not used in this country until the 1850's. Coiza oil (pressed from wild cabbages) replaced whale oil in the early 1850's, but our farmers lack of interest in growing this caused the service to switch to lard oil in the mid 1850's. Kerosene started replacing lard oil in the 1870's and the service was finally totally converted by the late 1880's. Electricity started to replace kerosene around the turn of the century. All U.S. lighthouses had Fresnel lenses by 1860.

*Lighthouses are constructed of wood, granite, brick, sandstone, steel, cast iron, reinforced concrete and one has an outer skin of aluminum.

*The source of light is called the 'lamp' (be it electric or fueled by oil), the magnification of the light is caused by the 'lens' or 'optic'. They are located in the 'lantern room' of the tower and the glazings are called 'storm panes'.

*The reflector system and the Fresnel system had fixed (steady light) and revolving (flashing) optics. The type of signal is called the characteristic. Other characteristics are occulting, group flashing, quick flashing, and equal

interval. Some lighthouses display a green or red light and some a white light with a green or red sector created by substituting a colored 'storm' for a clear one.

*One to five keepers manned light stations.

*Uniforms were not introduced into the Lighthouse Service until 1884.

*Keepers were paid a lower middle class wage. George Worthylake, our first, received 50 pounds (\$250) a year. By today's standards that would be the equivalent of \$16,000. During the 19th century, the Head Keeper's pay ranged from \$250 to \$600, others were paid less. The exception to this was in the West, where keepers were paid \$1,000 during the Gold Rush. The service supplied certain foodstuffs during most of their history.

*There were many female lighthouse keepers (U.S. Lighthouse Society has files on 80), but most obtained their position when their spouses or male relatives died or became incapacitated.

*The most powerful optic produces a light seen 25 miles at sea. Although aircraft have reported picking up a light at 40 or 50 miles.

*Towers are given special (painted) patterns -- diamond shapes, spirals, stripes, etc. -- or colors to distinguish them from each other.

*Some famous American lighthouses are:

Marblehead - Oldest on the Great Lakes

Makapuu Point, Oahu, HI - Has the largest lens in this country

Navesink, NJ - Site of first Fresnel experiments in this country

Point Pinos, CA - Oldest (continuous) on the West Coast (with original 3rd order lens)

St. George Reef, CA - Most expensive

Split Rock, MN- One of the prettiest settings

Thomas Point Shoal, MD - Last screw-pile on Chesapeake Bay

Tillamook Rock, OR and Minots Ledge, MA - Exemplary engineering feats.

ACTIVITIES

ART

Class Projects --Murals

1. Stag Light (or light tower with no family living in it)

Divide class into 5 teams, one for each floor of the lighthouse, providing each team with a piece of poster board showing outline of their floor.

Team will draw appropriate furniture, equipment or supplies for that floor. (or cut out and paste on.)

Example -Storeroom--barrel, wooden box, oil drum Bedroom - bed, picture, door to bathroom

Galley (Kitchen) - stove, pots and pans, icebox (or refrigerator), sink, table, and chairs

Recreation Room - bookshelf, TV, chairs, sofa Draw as one -. Watch or Service Room--oil drum, supplies

Lantern Room--lens

Tape them all together on wall to produce one tall stag lighthouse.

2. Marine Mural

Draw rocky shore, sandy beach with dunes, marine life under the sea, as well as in tidepools, buoys, lighthouse, pier, fishing and pleasure boats, ocean-going vessels, shorebirds, and gulls.

3. Lighthouse geographical and architectural mural

Students draw various locations lighthouses are found and then determine the appropriate design for each place -rocky cliff -a short tower (so as to be visible below fog or due to height of cliff), sandy shoal - a tall tower, either

cylindrical or conical, island - a spark plug or caisson lighthouse, harbor entrance - could have a varied design.

Older children studying landforms could be given a topographical map showing a coastline to determine where they think lighthouses should be located.

4. Coastal, River, Bay or Sound Map of Lighthouses

Use pre-drawn map of any of above or teacher draw map of area where several lighthouses are located. (in children's own state where applicable.)

If children live in N.Y., Michigan, or Maine, choose a particular section of shoreline or a limited number of the more important lighthouses.

Teacher or students to locate places on map where various lighthouses can be found, and mark on map with an X.

Make paper or cardboard 2D model of each lighthouse, and place on map in proper location with double-sided Scotch tape. Leave for a few days. Remove the lighthouses and play a game to see if children can place them in their proper location.

Each child could pick a particular lighthouse and write a few sentences about it giving factual information.

Individual Projects

1. Younger Children - give each child basic shapes to cut out, cylinder, cone, triangle, rectangle, square, half circle Using shapes paste together on blue background to form a lighthouse. Record what shapes were used and where.

This can be done as a mathematical exercise in visualizing and representing shapes by using 3 -D materials and constructing a lighthouse.

For higher grade levels, geometric shapes (pentagon, octagon, polygon, etc.) can be identified in photographs of lighthouses. The pattern design can then be reproduced as a 3-D image.

2. Reverse Image

Give each child a piece of blue construction paper. Using chalk or white poster paint, brush and sponge, let each child draw gulls, rocks, waves, clouds, fog, a lighthouse and whatever else their imaginations wish to depict.

3. Jigsaw Puzzles

Give each child a piece of construction paper to draw a lighthouse and color. Cut out, mount on cardboard, then cut into pieces to make a jigsaw puzzle. Exchange with another student to piece together.

4. Daymarks - Patterns of bright colors and bold design that help identify each lighthouse during daylight hours.

Use enclosed daymark outlines (enlarged) with instructions. (See page 21). Give an outline of a lighthouse to each child to create his/her own self-stylized daymark.

5. Lantern Room

Using pre-drawn lantern room, have children mark various items - dome, lens, galleries, lightning rod, etc.

6. Collage

Make a lighthouse collage using old cards, calendars, pictures, etc.

7. Stencil

Design a lighthouse stencil and use it to decorate.

8. Home Project - Constructing a Lighthouse

Using recyclable materials, such as glass jars and bottles, aluminum pie plates and foil, paper towel and toilet paper rolls, a shoe box, newspaper, magazines, paper bags, rubber bands, paper clips, plastic milk containers, 6-pack rings, have children construct a lighthouse or a light station.

LANGUAGE ARTS

Teacher read a lighthouse story to the class:

After initial storytelling, teacher start the story, then have children retell, recounting the various details or give an individual word from the story to each child and have them recount some event in the story using that word. You may want to let the children write their own lighthouse stories using that word, which could also be illustrated.

SCIENCE

The Properties of Light

1. Light travels in a straight line if it is not interrupted.
2. When light strikes a surface, it can be reflected, transmitted or absorbed, or a combination of all three.
3. Light travels through some objects but not through others.

Exercises

- a. Use a flashlight to explain the principle of reflection, which is used in the parabolic reflector. The silver reflector behind the bulb acts like a mirror, concentrating the light, and increasing its brightness.
- b. Shine a flashlight on an opaque object such as a desk; this will block the light. The object absorbs (assimilates or takes in) the light.
- c. Shine the flashlight through a drinking glass, a transparent object (one that lets the light pass through).

Most of the light will be transmitted (transferred or passed along).

- d. Using a prism run the beam of a flashlight horizontally across the room. Place the prism in front of the beam and it will refract (bend) the light, breaking its normal path and causing it to shine on the ceiling, spreading out 1" in all directions.

This demonstrates the principle of the Fresnel lens. The prisms and convex lens (curved outwards) work two ways; their shape and location also influence their effectiveness. The convex lens refracts (bends or slants) the rays of light as they pass through. The prisms first refract and then reflect (throw out) the light as it passes through.

Light can be classified according to its brightness:

candlepower

wattage

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Glossary of Lighthouse Terms

ARGAND LAMP: A hollow wick oil lamp. (see wick)

AEROBEACON: A modern-day type of light presently used in many lighthouses to produce a characteristic.

ASTRAGAL: Metal bar (running vertically or diagonally) dividing the lantern room glass into sections.

BULLSEYE: A convex lens used to concentrate (refract) light.

CHARACTERISTIC: Individual flashing pattern of each light.

DAYMARK: Unique color scheme and/or pattern that identifies a specific lighthouse during daylight hours.

FIXED LIGHT: A steady non-flashing beam.

FOG SIGNAL: A device (such as a whistle, bell, canon, horn, siren, etc.) which provides a specific loud noise as an aid to navigation in dense fog.

FRESNEL LENS: A type of optic consisting of a convex lens and many prisms of glass which focus and intensify the light through reflection and refraction.

FUEL: A material that is burned to produce light (fuels used for lighthouses included wood, lard, whale oil, tallow, kerosene.) Today, besides electricity and acetylene gas, solar power is also used.

GALLERY: On a lighthouse tower, a platform or walkway or **BALCONY** located outside the watchroom (main gallery) and/or lantern room (lantern gallery.)

KEEPER: The person who takes care of the light in the lighthouse. (The Head Keeper is responsible for the operation of a light station.)

LAMP: The lighting apparatus inside a lens.

LANTERN ROOM: *Glassed-in housing at the top of a lighthouse tower containing the lamp and lens.*

LENS: A curved piece of glass for bringing together or spreading rays of light passing through it.

LIGHTHOUSE: A lighted beacon of major importance in navigation.

LIGHT STATION: A complex containing the lighthouse tower and all of the outbuildings, i.e. the keeper's living quarters, fuelhouse, boathouse, fog-signaling building, etc.

LOG: A book for maintaining records, similar to a diary.

NAVIGATION: Travel over water.

ORDER: Size of the Fresnel lens which determines the brightness and distance the light will travel.

PARABOLIC: A bowl-like **METAL** device, silver plated, **REFLECTOR** with a small oil lamp in the center.

PHAROLOGIST: One who studies or is interested in lighthouses.

PRISM: A transparent piece of glass that refracts or disperses light.

REFLECT: Bend or throw back light.

REFRACT: Bend or slant rays of light.

REVOLVING LIGHT: One that produces a flash or characteristic.

SPIDER LAMP: Shallow brass pan containing oil and several solid wicks.

STAG LIGHT: A lighthouse with no family living in it, i.e. inhabited by men only.

TOWER: Structure supporting the lantern room of the lighthouse.

WATCH ROOM: A room immediately below the lantern room or **SERVICE ROOM** where fuel and other supplies were kept where the keeper prepared the lanterns for the night and often stood watch. The clockworks (for rotating lenses) were also located there.

WICK SOLID: A solid cord used in spider lamps that draws fuel up to the flame by capillary action.

HOLLOW: A concentric cotton wick used in Argand and other lamps.

"WICKIE": A nickname given to lighthouse keepers derived from the task of trimming the wick of the lamps.
