# Through the Lighthouse Lens

**Average Program Length**: 45 minutes
**Meeting Location**: Outside the Lighthouse
**Total material list:**
--Speaker or Boombox
--Pocket sized Fresnel lenses
--Flashlight
--Sewing machines
--Markers
--Clear Plastic cups
--Pencils
--Blank Paper
--Corn Husks
--Yarn and felt
--Glue

## Activities by Scout Level

### Girl Scouts

**Daisies and Brownies**- pick at least 3 of the steps below
**Juniors and Cadettes**- pick at least 4 of the steps below
**Seniors and Ambassadors**-pick at least 5 of the steps below

### Boy Scouts

**Lions, Tigers, Wolves, and Bears**- pick at least 3 of the steps below
**Webelos, Scout Rank, and Tenderfoot**- pick at least 4 of the steps below
**Second Class, First Class, Star Scouts, Life Scouts, and Eagle Scouts**-pick at least 5 of the steps below

# Background

The Old Point Loma lighthouse was in operation from 1855 to 1891. After the CA Gold Rush and statehood, there was an increase of sea traffic, so the government built 16 lighthouses on the West Coast to direct boats. This was one of them. The lighthouse had to be staffed 24 hours a day. The duties of a keeper and assistant keeper were not difficult and were carefully spelled out in various instruction booklets. The work included cleaning and polishing the lens, cleaning and filling the lamp, removing all dust from the framework of the apparatus, and fitting and trimming the wicks. A linen apron was worn during this cleaning process to ensure the lens would not be scratched. The lighthouse staff also alternated watches and performed the most important function of all: keeping the light burning from sunset to sunrise.

The lighthouse sits atop Point Loma, 422 feet above sea level, overlooking the Pacific Ocean to the west and the entrance to San Diego Bay to the east. The light, at an elevation of 462 feet, was the highest navigational beacon in the United States during its 36 years of operation. The lighthouse was pulled out of operation, though, because it sat too high, and the New Point Loma Lighthouse was built at lower elevation.

The life of a lighthouse keeper was lonely. It was 10 miles into town on a horse or in a wagon, so people living in the lighthouse rarely saw others. What do you think people did to pass the time?

To pass the time, residents of the lighthouse read, played cards, did crafts, made shell hangings, knitted, cooked, baked, etc. They also cared for their chickens, goats, and horse that they kept on the property. In the 1880s, the governmental Lighthouse Board offered a “portable library” to keepers. The books were set upright on a table, with about 50 different books of all types. This provided leisure to pass the time as well. Furthermore, the governmental Lighthouse Board would drop off food rations of 200 pounds of dried pork, 100 pounds of beef, 2 barrels of flour, 50 pounds of rice, 50 pounds of brown sugar, 25 pounds of coffee, 10 gallons of beans or peas, 4 gallons of vinegar, and 2 barrels of potatoes a year. With the lack of food choices and amounts, lighthouse keepers tried to keep a garden, and spent much time gardening.

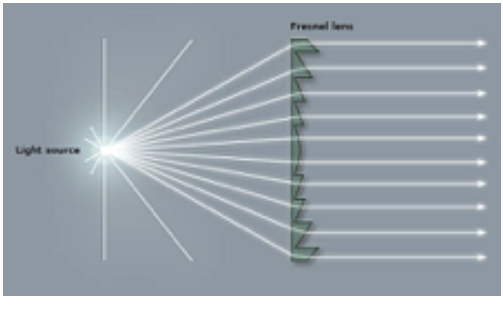
However, with the lack of water, there was little success. San Diego gets about 10 inches of rain a year, and keepers stored the rainwater in one cistern in the basement (later two more cisterns were added, and so was the large concrete basin in front of the lighthouse). Much time was spent traveling 7 miles to a well in La Playa to collect barrels of water, and haul it back over a long, bumpy road with a steep drop into Point Loma and back. Go to the garden. What crops do they grow here? These ones are drought resistant. Now and then, townspeople would come out to lighthouse to have picnics and dance in the barn. This was a highlight of lighthouse life.

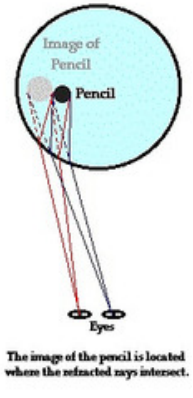
The type of light that we have in the lighthouse is a Fresnel Lens. Fresnel Lenses works through concentrating rays. The rings on the lens (called steps) each bend light more than one below it so beam can travel on a parallel across the ocean.

The parts of the Fresnel lens bend the light so a lot of it points in the same direction. The bending is called “refraction” and happens because light moves differently in air than in the glass of the lens. Refraction also happens in water. For example, if you get a plastic glass and fill it half full of water, and stick a pencil in the middle of the glass, you can “break” it, as it looks like the pencil is in two pieces.

As light travels through a given medium, it travels in a straight line. However, when light passes from one medium into a second medium, the light path bends. Refraction takes place. The refraction occurs only at the boundary. Once the light has crossed the boundary between the two media, it continues to travel in a straight line. Only now, the direction of that line is different than it was in the former medium. If when sighting at an object, light from that object changes media on the way to your eye, a visual distortion is likely to occur. This visual distortion is witnessed if you look at a pencil submerged in a glass half-filled with water. As you sight through the side of the glass at the portion of the pencil located above the water's surface, light travels directly from the pencil to your eye. Since this light does not change medium, it will not refract. (Actually, there is a change

of medium from air to glass and back into air. Because the glass is so thin and because the light starts and finished in air, the refraction into and out of the glass causes little deviation in the light's original direction.) As you look at the portion of the pencil that was submerged in the water, light travels from water to air (or from water to glass to air). This light ray changes medium and subsequently undergoes refraction. As a result, the image of the pencil appears to be broken. Furthermore, the portion of the pencil that is submerged in water appears to be wider than the portion of the pencil that is not submerged. These visual distortions are explained by the refraction of light.




Refer to http://amhistory.si.edu/ourstory/pdf/water/water_lighthouses.pdf with additional questions.

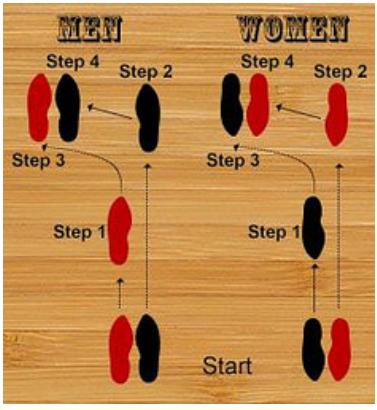
## Matching Badges

Brownie-Dancer

Correlates to Next Generation Science Standards for PS4 WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER

# Program Activities

1.  Learn a Classic 19th century dance! The most popular dances for the middle-class at this time were the Waltz and the Two-Step. Discover how to two-step near the Lighthouse where townspeople would have celebrated in the same way, hundreds of years ago.




2. Practice "breaking" a pencil using refraction of water.Get a plastic glass and fill it half full of water. Then, find a pencil, and stick it in the middle of the glass. You can “break” it, as the refraction creates the illusion that the pencil is in two pieces.

3. Experiment with using the the pocket Fresnel on different objects at different distances. Use the flashlight to shine the light through the lense. Turn it sideways and look closely to see the tiny plastic parts that make up the whole lens.

4.If you are outside, look at a parked car nearby. Examine the headlights to see if they include any Fresnel lenses.

5. Now that you have learned how Fresnel lenses work and seen one in real life, think of a new way you could use a Fresnel lens. Fresnel lenses can magnify words or images that are close by, or send light very far into the distance. What invention could you make that would use a Fresnel lens? What problems can you think of that could be solved with a strong beam of light? Maybe think about problems you face everyday or problems you think might exist in the world of the future. How does the Fresnel lens you saw in real life inspire you? Are there any lessons you could learn from that Fresnel invention? On a blank piece of paper, draw a picture of how your invention might look, and turn it into the staff member at the visitor center.

6. Help Cabrillo National Monument by designing lighthouse period clothing for our demonstrations. From the research you conducted, sketch out an image of what you think a historically accurate clothing piece would look like for a man, woman, or child. If you would like, you can also use a sewing machines to create an actual piece for the Park to use.

7. The children of the lighthouse keepers often had to make their own toys. Make corn-husk dolls for display in the lighthouse, or for you to take home. Start by soaking the husks in water for 10 minutes, and then blot excess water with a paper towel. Lay 4 or 6 husks (always an even number) in a stack. Using thin twine, tie husks together, about 1 inch from the top. Separate husks into equal portions (2 and 2, or 3 and 3), and fold halves down, covering twine. Using thin twine, tie husks about 1 inch down, creating head. Roll a single husk and tie at ends to make arms. Position arms below knot at neck, between equal portions of husks.Tie waist. For female doll, trim husks to an even length.For male doll, separate legs into equal portions. Tie at knees and ankles. Trim evenly. To make hair, glue yarn or raffia to the heads. Fashion clothes from pieces of felt: Cut rectangles, and snip slits or X's in the center; then slide over doll's head, and secure around the waist with a strip of felt or yarn. (Glue on buttons, and use scissors to make fringe as desired.) Create hats and bonnets by cutting felt to fit, and then gluing in place.