The Lighthouse Circuit

A FREE THREE-DAY UNIT · GRADES 4–5

Why the Light Reached So Far

How a small lamp guided ships home, and who kept it burning.

DAY 1
The light
A lens, a flashlight and a dark room

DAY 2
The people
A real logbook and two true stories

DAY 3
My lighthouse
Research one and pitch the trip

Teacher guide, student pages and a family note in English and Spanish.

Free to copy for classroom use. No sign-up, no ads. · lighthousecircuit.com/teachers

At a glance

Students find out how one oil lamp could be seen many miles out to sea, why California needed that in a hurry, and who kept the lights burning.

Grades	4 and 5
Time	Three 45-minute lessons. Day 1 works on its own.
Subjects	Science (light, engineering), California history, short research writing
Prep	10 minutes. No lighthouse knowledge needed.
Cost	Free. No accounts, ads or sign-ups on the website.

Students will be able to

- Explain the problem a lighthouse solves and why California built its first ones in the 1850s.
- Show, with a lens and a small light, how spreading light is gathered into a beam.
- Explain how sailors told one lighthouse from another by its pattern of flashes.
- Read a real keeper's log and say what it tells us.
- Find one California lighthouse and report on it.

You need

- A projector or shared screen, open to lighthousecircuit.com/fresnel-lenses
- One magnifying glass and one small light per group. A phone flashlight or keychain LED works best.
- A room you can dim, and a blank wall
- The student pages, one set per student
- Student devices for Day 3, or do it together on the projector

BACKGROUND FOR YOU

Five things worth knowing

You can teach this cold. These five facts are the ones students ask about, and each is sourced on the website.

California's lighthouses are a Gold Rush story

After 1849, ships poured into San Francisco along a foggy, rocky coast with no lights at all. Hundreds wrecked near the Golden Gate in those years. The first West Coast light was lit on Alcatraz in 1854. Point Pinos in Pacific Grove followed on February 1, 1855.

A bare lamp wastes most of its light

It shines up at the sky and down at the floor as much as out to sea. Before the lens, lighthouses used mirrors behind the lamp, which lost more than half the light.

The Fresnel lens was the fix

In the 1820s a French engineer, Augustin-Jean Fresnel (say "fray-NEL"), ringed a lamp with glass prisms that bend the stray light into one flat beam aimed at the horizon. Very little is lost. The largest size, a "first-order" lens, stands about eight and a half feet tall. The one made for Pigeon Point has 1,008 prisms and arrived in 72 crates after a voyage around Cape Horn.

Every lighthouse had its own signal

Some shone steadily. Others flashed in a set rhythm, made by turning the lens with clockwork that a keeper wound by hand. A captain who counted the seconds between flashes knew exactly which point of land he was looking at.

People made it work

Keepers trimmed the wick, polished the glass and wound the clockwork every night of the year. Emily Fish kept the Point Pinos light from 1893 to 1914. At Point Reyes, a separate crew called surfmen patrolled the beach and rowed out through the breakers to rescue shipwrecked sailors. In 1913 they brought all 21 men off the wrecked steamer Samoa without losing one.

Sources: lighthousecircuit.com/fresnel-lenses (23 sources listed at the foot of the page), lighthousecircuit.com/people-behind-the-light, and the National Park Service's Point Reyes life-saving history at nps.gov/pore.

DAY 1 · 45 MINUTES

The light

0–5	**The hook** Dim the lights.	"It is 1853. You are on a sailing ship off California in thick fog, at night. No GPS, no radio, no map you can trust. Somewhere ahead are rocks. How do you find out where they are before you hit them?" Take every answer. Then: "That year a ship called the Carrier Pigeon hit the rocks south of San Francisco. The place is still called Pigeon Point."
5–10	**The problem** Hold up one small light in the dim room.	"Here is my lighthouse lamp. Where is the light going?" (Everywhere.) "How much of it is going toward the ships?"
10–20	**The lens** Project the Fresnel lens page: one lamp, one beam; the seven sizes; the Point Pinos lamps.	"Predict first: what will the glass do to the light?" At the sizes: "Which one would you put on a dangerous point far from any harbor? Which in a small bay?"
20–32	**The experiment** Groups of three or four. See the next page.	"Make the brightest, smallest spot you can on the wall. You may only move the lens."
32–40	**Flash codes** Lights back up. Each group invents a flash pattern and another group decodes it.	"If every lighthouse just shone, how would a captain know which one he was seeing?"
40–45	**Exit question** One sentence on the student page.	"A lighthouse lamp was small. Why could ships see it from so far away?"

Short on time?

Do the hook, the lens page and the exit question, and run the experiment another day.

DAY 1 · 12 MINUTES

The experiment: bend the light

Students use a lens to turn a spreading glow into a tight, bright spot. That is the job a lighthouse lens does.

1. Dim the room. One student holds the small light about an arm's length from the wall and points it at the wall.
2. Everyone looks at the glow. Is it big or small, bright or faint, sharp or fuzzy?
3. A second student holds the lens right in front of the light, then slowly moves the lens toward the wall.
4. The group calls "stop" where the spot is smallest and brightest. A third student measures how far the lens is from the light.
5. Move the lens past that point and watch the spot spread out again.
6. Each student draws two pictures on the student page: the light without the lens and with it, using arrows.

What they should notice

The light did not get stronger. The same light was gathered from many directions and sent one way. That is why a small lamp could reach ships far offshore.

Ask afterward

"A lighthouse lens is taller than your teacher. Why build it that big?" A bigger lens catches more of the lamp's light.

Use a real Fresnel lens if you can

The flat plastic magnifier sheets sold for reading small print are Fresnel lenses. Hold one to the light and students can see the rings. The lesson works with an ordinary magnifying glass too, so do not wait for an order.

Safety

Never look at the sun through a lens, and never shine a light into anyone's eyes. Keep lenses away from sunny windows.

DAY 2 · 45 MINUTES

The people

Students meet the people who kept the lights and saved lives, using a real logbook and two true stories.

0–7	**The fog bell** Tell the story, then have the class tap the rhythm on their desks for one full minute.	"July 1906. Fog fills San Francisco Bay, and the machine that rings the warning bell on Angel Island breaks. The keeper, Juliet Nichols, picks up a hammer. She strikes the bell twice every fifteen seconds." After the minute: "How long could you keep that up? She did it for more than twenty hours, until the fog lifted."
7–17	**Log detectives** Show the three log entries on the Day 2 student page.	"Each of these is a whole day's entry. What can you work out from them? What kept breaking? Why would windows matter so much on a windy point?"
17–30	**The rescue** Tell the story of the steamer Samoa in five beats: fog, the whistle, the cart, the rope, the count.	"The ship is 600 yards down the beach in heavy surf. You have a rowing boat and you have a rope. Which do you use, and why?" Then tell them: the crew used the rope, and all 21 men lived.
30–40	**Write a log** Three short lines for one night as a keeper or a surfman.	"Logs were short. Say what the weather was, what you did, and one thing that went wrong."
40–45	**Share and choose** Three volunteers read theirs.	"Keeper, surfman, lens maker, or sailor on the supply ship: which job would you have wanted, and why?"

Background

Juliet Nichols kept the Point Knox station from 1902 to 1914. Her own report gives 20 hours and 35 minutes. The Samoa went aground on January 28, 1913, near the Point Reyes Life-Saving Station. Sources are listed on the teachers page.

DAY 3 · 45 MINUTES

My lighthouse

Students become the class expert on one California lighthouse and try to talk a classmate into visiting it.

0–5	**Find the nearest one** Project the atlas at lighthousecircuit.com.	"Which lighthouse is closest to our school? Has anyone been to one?"
5–25	**Research** Students choose a lighthouse from the atlas and complete the Day 3 student page.	"Pick one you would want to stand in front of. Find the facts on your page, and one thing you still wonder about."
25–40	**The one-minute pitch** Groups of four. Each student has one minute. Each group sends its most convincing pitch to the front.	"You are not reading your page. You are selling the trip. What would we see? What is the best story?"
40–45	**Send it home** Hand out the family note.	"If you go, bring back one thing the website did not tell you."

No student devices?

Choose Point Pinos, Pigeon Point and Point Reyes, project each entry for five minutes, and let students pick among the three.

Teaching fourth grade?

Every U.S. fourth grader can get a free Every Kid Outdoors pass that covers national park entrance fees for the family. Many California lighthouses are free to visit without it.

FOR EVERY STUDENT

Words to know

Lens	A piece of curved glass that bends light
Prism	A wedge of glass that turns light in a new direction
Beam	Light that travels together in one direction
Fresnel lens (fray-NEL)	A lighthouse lens built from many prisms around one lamp
Keeper	The person in charge of a lighthouse
Fog signal	A bell, whistle or horn that warns ships when fog hides the light
Surfman	A trained rescuer who rowed out through the waves to save sailors
Breeches buoy	A canvas seat on a rope, used to pull people from a wreck to shore
Flash pattern	The rhythm of a lighthouse's flashes, different for each one
Logbook	The daily record a keeper wrote of weather and work

Making it work for every student

English learners

Put the ten words on cards with a sketch before Day 1. Offer a sentence frame for the exit question: "The lens ____ the light, so ____." The family note comes in Spanish.

Students who need more support

Every written answer can be a labeled drawing. In the experiment, give one clear job each: hold the light, move the lens, call stop, measure.

Students who finish early

"Design a lighthouse for our town. Where would it stand, what would its flash pattern be, and who would keep it?"

ASSESSMENT

Check for understanding

Why did California build lighthouses in the 1850s?	The Gold Rush brought many ships to a foggy, rocky coast, and ships were wrecking.
What is wrong with a lamp on its own?	Its light spreads in every direction, so most of it never reaches the ships.
What does a Fresnel lens do?	It bends the spreading light into one beam aimed out to sea. It does not make more light.
How could a captain tell two lighthouses apart at night?	Each had its own pattern: steady, or flashing in its own rhythm.
Who kept the light working?	Keepers, who trimmed the wick, cleaned the glass and wound the clockwork every night.

Stretch question for fifth graders

"Lighthouses today mostly use small electric lights and ships have GPS. Give one reason to keep the old lenses anyway." Accept any reasoned answer: history, backup when electronics fail, beauty, the craft of the people who made them.

Standards this unit supports

These are suggested alignments. Please check them against your own district's pacing guide.

NGSS 4-PS4-3: compare solutions that use patterns to transfer information	Flash codes
NGSS 4-PS3-2: energy can be transferred from place to place by light	The experiment
NGSS 3-5-ETS1-1 and 3-5-ETS1-2: define a design problem; compare solutions	Bare lamp, mirrors and lens as three answers to one problem
California History–Social Science 4.3 and 4.4: the Gold Rush, statehood and California's growth after 1850	The hook and the background
Common Core W.4.7 and W.5.7: short research projects	My lighthouse
Common Core RI.4.7 and RI.5.7: use information from digital sources	Reading the atlas entry

BEYOND THE LESSON

Who keeps the lights today

Most California lighthouses are cared for by small volunteer groups, and several are raising money to restore a tower or put a lens back in place. The Lighthouse Circuit takes no share of any donation.

Point Pinos Lighthouse	Point Pinos, Pacific Grove · pointpinoslighthouse.org
Central Coast Lighthouse Keepers	Point Sur, Big Sur · pointsur.org
Point Arena Lighthouse Keepers, Inc.	Point Arena · pointarenalighthouse.com
Point Cabrillo Lightkeepers Association	Point Cabrillo, Mendocino · pointcabrillo.org
East Brother Light Station	East Brother, Richmond · ebls.org
Point San Luis Lighthouse Keepers	Point San Luis, Avila Beach · pointsanluislighthouse.org
Del Norte County Historical Society	Battery Point, Crescent City · delnortehistory.org/lighthouse
Piedras Blancas Light Station	Piedras Blancas, San Simeon · piedrasblancas.org
U.S. Lighthouse Society	Nationwide · uslhs.org

Three ways a class can take part

Write to the keepers

Write to the group that keeps the lighthouse your class chose. Ask one question the website could not answer. Volunteers usually write back.

Hold a coin drive

Collect coins for one lighthouse and send them with the students' drawings.

Invite a docent

Ask a volunteer to visit, in person or by video.

Questions or corrections about this unit: hello@lighthousecircuit.com

DAY 1

The Light

The Lighthouse Circuit

Name _____ Date _____

1. Draw the light. Use arrows to show where the light goes.

Lamp alone	Lamp with a lens

2. Our experiment

Without the lens, the spot on the wall was _____

With the lens, the spot on the wall was _____

Did the light get stronger, or did it get gathered together?

_____

3. My flash code. Fill a box for a flash. Leave a box empty for dark. Fill two in a row for a long flash.

Could another group read my code? Yes No

4. A lighthouse lamp was small. Why could ships see it from so far away?

_____

_____

_____

DAY 2

The People

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Name _____ Date _____

1. Read the keeper's log. These are real entries from Point Reyes Lighthouse in 1888.

January 26	*Repairing governor of Siren Engine*
February 13	*Put 2 new belts in north siren and packed top of it with sheet lead and canvas*
February 21	*Carpenters repairing windows. Keeper repairing signal. Put in new lamps and s. valve cords*

Source: National Park Service transcription of the Point Reyes keeper's log. The siren was the station's fog signal.

2. Be a log detective.

What the log says	What I think it means

3. Write your own log for one night. Keep it short, like a real keeper.

I am a keeper surfman (circle one)

Weather: _____

What I did: _____

_____

What went wrong: _____

_____

4. The job I would choose, and why:

_____

_____

DAY 3

My Lighthouse

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Name _____ Date _____

My lighthouse is called _____

It is near the town of _____

It was first lit in the year _____

The lens it had: _____

Where that lens is now: _____

Can you visit it today? What can you see there? _____

_____

1. Draw my lighthouse.

2. My one-minute pitch. Three things I will say to make you want to go:

1 _____

2 _____

3 _____

3. One thing I still wonder about my lighthouse:

_____

_____

FOR FAMILIES

Ask your family to take you to a lighthouse

The Lighthouse Circuit

Dear families,

This week we learned how lighthouses work and why California built them. Your child chose one to study:

_____

California has 50 lighthouse sites, and many are free to visit. If you would like to go, the free guide at lighthousecircuit.com shows which ones are open, what you can see there and what to check before you drive. There is a free Lighthouse Passport your child can stamp at each one. No account or sign-up is needed.

Good first visits with children: Point Pinos in Pacific Grove, Pigeon Point near Pescadero, Point Vicente in Rancho Palos Verdes and Old Point Loma in San Diego.

If you go, ask your child to bring back one thing the website did not say.

From your child's teacher, _____

PARA LAS FAMILIAS

Pidan a su familia que los lleve a un faro

The Lighthouse Circuit

Estimadas familias:

Esta semana aprendimos cómo funcionan los faros y por qué California los construyó. Su hijo o hija eligió uno para estudiar:

_____

California tiene 50 sitios de faros y muchos se pueden visitar gratis. Si desean ir, la guía gratuita en lighthousecircuit.com (en inglés) muestra cuáles están abiertos, qué se puede ver y qué conviene revisar antes de salir. También hay un Pasaporte de Faros gratuito que su hijo o hija puede sellar en cada visita. No hace falta crear una cuenta ni registrarse.

Buenas primeras visitas con niños: Point Pinos en Pacific Grove, Pigeon Point cerca de Pescadero, Point Vicente en Rancho Palos Verdes y Old Point Loma en San Diego.

Si van, pídanle a su hijo o hija que traiga un dato que el sitio web no mencione.

De parte del maestro o la maestra, _____