

Where in the World are the Northwestern Hawaiian Islands?



Lesson at a Glance

Students will create a model that explains where the Northwestern Hawaiian Islands are located and what they islands look like.

Objectives

Students will be able to:

- Locate and name all of the Hawaiian Islands.
- Describe the characteristics of each island.
- Explain what kind of islands they are.

Background Information

The Northwestern Hawaiian Islands are an archipelago or island chain that stretches 1,200 miles northwest of the main Hawaiian Islands. These 10 islands vary from islands made of high rocky cliffs to low islands, to sandy atolls. Millions of sea birds, monk seals and the green sea turtles are dependent upon these islands and surrounding reefs. These islands cover over 11,000 square kilometers of coral reef habitat and represent over 70% of all coral reefs found in the world.

The Hawaiian Islands are part of a long line of underwater volcanoes. A hotspot located under the oceanic plate spews out hot molten rock, creating a volcano. These undersea volcanoes eventually reached the surface of the ocean creating islands. These islands continue to grow as long as the lava continues to flow. The Pacific Plate moves slowly over the hotspot creating new islands. These volcanic islands are slowly sinking and eroding away. Eventually these high rock islands become atolls, or rings of coral. The Northwestern Hawaiian Islands includes 3 types of islands: Nihoa, Necker and Gardner Pinnacles are volcanic basalt cliffs, Laysan and Lisianski are coral islands with fringing reefs, and French Frigate Shoals, Maro Reef and Hermosa , Midway and Kure are atolls.



Materials Needed

- Map of the Hawaiian Islands Archipelago (includes main and Northwestern Hawaiian Islands)
- Fact sheets on each of the Northwestern Hawaiian Islands.
- Rulers/pencils and colored pens.
- Materials for creating maps or models. See student activities below for ideas.
- Access to computers if possible to have students to research the islands.

Student Activity:

Listed below are suggestions of mapping activities. The term Hawaiian Islands refers to the main and northwestern Hawaiian Islands. The following islands need to be included: Hawaii, Kahoolawe, Maui, Lanai, Molokai, Oahu, Kauai, Niihau, Nihoa, Mokumanamana, French Frigate Shoals, Gardner Pinnacles, Maro Reef, Laysan, Lisianski, Pearl and Hermes, Midway Atoll, Kure Atoll.

1. 3-D Map of the Islands.

Give students a copy of the Hawaiian Islands Archipelago map, to use as reference and copies of the island descriptions for information about the islands. Use clay, paper mache, or anything else the students come up with to create models of the Hawaiian Islands. Include on this model the edges of North America, Asia, Australia and the South Pole.

2. Mapping the Hawaiian Islands

Give students the map of the Hawaiian Island Archipelago to use as a reference. Give each pair or group of students a desk size piece of paper. Students are to figure out how to create a map of the Hawaiian Islands to scale. Challenge them to figure out how to use the latitude and longitude to replicate the map. Give the students copies of the Island descriptions. Have them draw an image of what each island looks like color it and cut them out. Locate where the islands belong, paste the islands on the map and name them. Indicate also on this map North America, Asia, Australia and the South Pole.



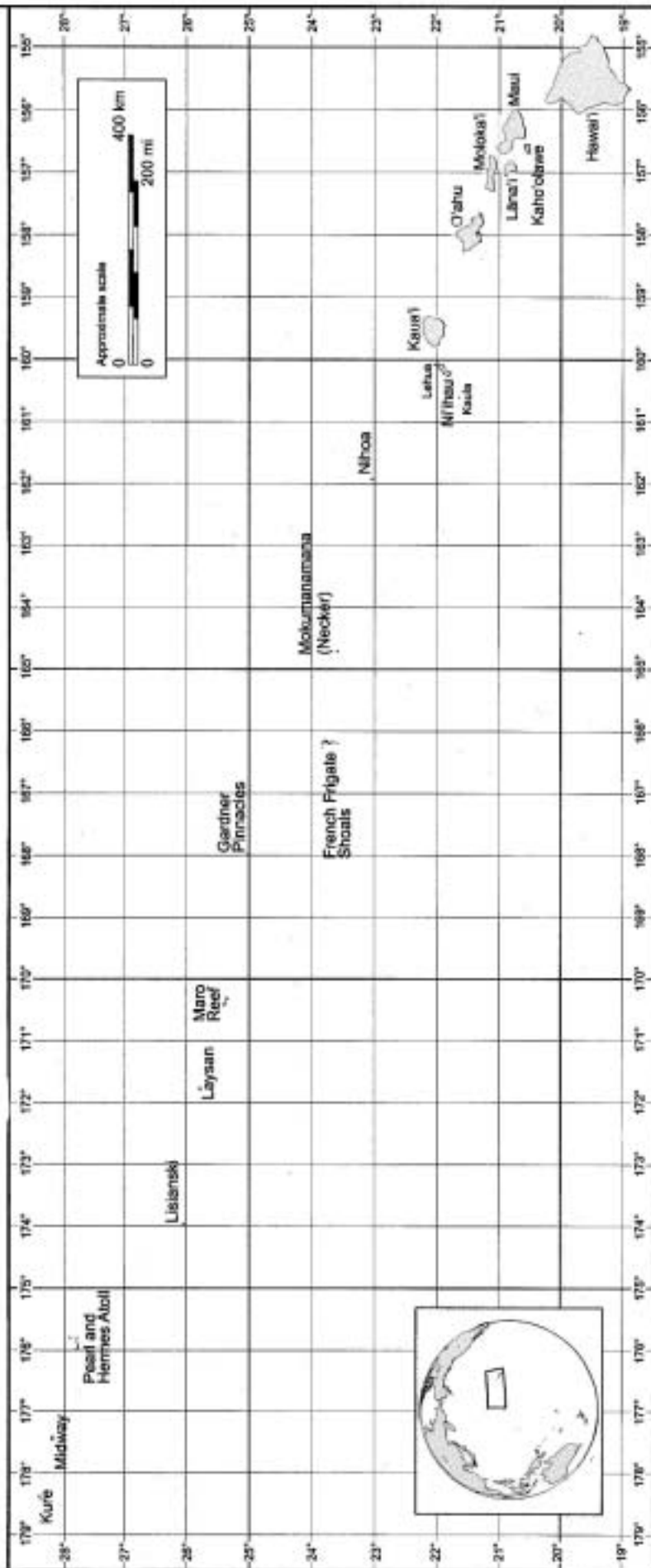
3. Create a Class Bulletin Board Map.

Assign each group of students a different island. Have them research the islands and make a poster of the island. They are to include the physical characteristics, flora and fauna and any interesting facts they can find about their island. Include surrounding reefs and any sea animals found primarily on/or around the island. Place the island posters on the bulletin board in the appropriate positions. Students may want to check out the following web sites for more information.

- Navigatingchange.org
- Hawaiianatolls.org
- PVS-Hawaii.com



Northwestern Hawaiian Islands



Navigating Change
Northwestern Hawaiian Islands

www.navigatingchange.org

PEARL AND HERMES ATOLL

Pearl and Hermes Atoll is a classic atoll that is primarily underwater and has numerous islets, seven of which are above sea level. The protective perimeter reef encircles all but the northwestern quadrant of the lagoon. Numerous small low coral islets are located behind the perimeter reef. While total land area is only 0.36 square km (80 acres), the reef area is huge, over 450 square miles (194,000 acres). The atoll is ever-changing, with islets emerging and subsiding.

Presently, about 160,000 birds from 22 species are seen. They include Black-footed albatrosses, Tristram's storm petrels, and one of two recorded Hawaiian nest sites of Little terns. Endangered Laysan Finch eke out a living on the tiny islands where they were translocated in the 1960's. They were introduced in an attempt to establish a "back-up" population.

The sandbar islets support coastal dry grasses, vines, and herbal plants, including 13 native species and 7 introduced species. The plants survive because they are salt-tolerant and able to recover from frequent flooding events.

Hawaiian monk seals and sea turtles breed and feed at Pearl and Hermes, and it is a mating area for spinner dolphins. The atoll has the highest standing stock of fish and the highest number of fish species in the NWHI. These include saber squirrelfish, eels, Galapagos sharks, sandbar sharks, ulua (big jacks), angelfish, aweoweo, uhu, and numerous lobsters. Hiding between the unique reef and lagoons are very unusual invertebrate habitats. For example, several sponges collected recently may be new to science!

Black-lipped pearl oysters, at one time very common, were harvested in the late 1920s to make buttons from their shells. Over-harvested, the oysters were nearly eliminated, and today only a handful remain even long after their harvesting was declared illegal in 1929.

NIHOA ISLAND

Nihoa is unlike any of the other Northwestern Hawaiian Islands (NWHI) with its 900 foot cliffs, basalt rock surface, and tiny beach. This island is about 1 square km (171 acres) and is at the southeastern end of the NWHI chain.

Although difficult to imagine today, this remote land of rugged cliffs and steep valleys provided a home for Hawaiians between A.D. 1000 and A.D. 1700. More than 80 cultural sites are known, including habitation terraces and bluff shelters, religious places, agricultural terraces, and burial caves. Many of the mea makamae (cultural objects) and structures associated with these wahi pana (cultural places) are similar to many found throughout the Main Hawaiian Islands. It is believed that the abundance of natural resources and at least three freshwater seeps may have supported as many as 175 people between A.D. 1000 and A.D. 1700.

The island's rugged landscape may seem uninhabitable from a distance but the very essence of Nihoa is life, a treasure chest of species found nowhere else in the world. Niches in rocky outcroppings support some of the most unique and varied insect, seabird, and plant life of all the NWHI.

Seventy-two terrestrial arthropods including giant crickets and earwigs, and two endemic landbirds, the Nihoa finch and Nihoa millerbird, are found only on Nihoa. Native endangered plants include a loulu or fan palm and 'ohai shrub.

Basalt underlies most shallow water habitats surrounding Nihoa. Limu (algae), wana (sea urchin), and opihi (limpet) inhabit these shallow waters, while sharks and jacks hover in deeper waters offshore.

In order to protect the island's fragile ecosystem, few visitors are allowed on Nihoa and strict protocols are required. Approval must be given by the U.S. Fish and Wildlife Service and is mostly granted to those doing cultural and scientific research.

MOKUMANAMANA (NECKER ISLAND)

About 155 miles northwest of Nihoa lies Mokumanamana, a small basalt island that is 1/6 square km, or 46 acres, in size. It is about one-quarter the size of Nihoa. Although the island is the second smallest of the NWHI, it has the second largest surrounding marine habitat (almost 385,000 acres). Large offshore areas include Shark Bay on the north side, West Cove and Northwest Cape as well as miles of shallow reef to the southeast. Island shorelines are generally steep around all sides except the east, where a shallow, wave-planed basalt shelf fills Shark Bay. West Cove, in the lee of the prevailing winds, affords the only semi-protected shallow submerged habitat off the island.

Necker Island's small size and steep topography explain its relatively small number of plant species, but all except one of the six species are indigenous and hosts a all exclusive native plant community. No non-native or alien species are allowed!

Sixteen of the seabird species typical of the NWHI nest at Necker, but the species favor cliff nesting sites (White Terns, Black Noddies, and Blue-grey Noddies) are particularly numerous there. The terrestrial life encompasses 15 endemic (found only on that island) insects such as wolf spiders and bird ticks.

Marine life includes gray reef sharks and manta rays. Hawaiian monk seals are seen on the island's rocky shores. A great abundance and diversity of sea cucumbers, sea urchins, and lobsters are found in Shark Bay. Little coral life exists in the shallow areas due to the constant wave action that scours the underwater basalt. Most reef life is found in holes and elevated areas protected from the currents. Below the shallow reef are extensive deeper "shelves" that extend many miles from the island, especially to the southeast. These broad offshore areas are used for commercial fishing.

Mokumanamana is known for its numerous religious sites and artifacts. Fifty-two sites have been found that appear to have been used mainly for worship. Since the island seems to be too small and dry for living, with poor soil for farming, archaeologists believe that the religious sites were probably used by Hawaiians. They visited from nearby Nihoa and other islands but didn't stay.

MIDWAY ATOLL

Midway, the best known Northwestern Hawaiian Island (NWHI), is a circular-shaped atoll with three small islets (Sand, Eastern, and Spit) on the southern end of the lagoon. While its land area is small, about 1,535 acres, the atoll has approximately 87,000 acres of reef area.

The atoll was designated as the National Memorial to the Battle of Midway in 2000. Today, many buildings and houses still exist from when it was an active Naval Base.

Today a fulltime Refuge staff administers a small visitor program, cares for its wildlife, restores native plant life, and protects historic resources.

Nearly two million birds of 19 species nest on Midway. The atoll has the largest Laysan albatross colony in the world. Other birds include black-footed albatross, red-tailed tropicbirds, white terns, black and brown noddies, shearwaters, and hundreds of thousands of Bonin petrels. One of the rarest is the endangered short-tailed albatross.

Three-fourths of Midway's plant species were introduced. These include weeds, ornamental shrubs, exotic vegetables, and trees such as coconut palms and ironwood. Major efforts are underway to control alien species and restore native habitats.

The waters abound with spinner dolphins, monk seals, and green sea turtles. More than 250 species of fish live in its waters, including the rare Hawaiian grouper (hapu`upu`u), jack (ulua), goatfish (kumu), and sharks. Beyond the reefs are pelagic fishes such as tuna and marlin.

Despite 100 years of human impact, the reef at Midway is rich and diverse. Sixteen species of stony coral have been reported, and scientists believe there may be many more. Marine habitats, including spurs, grooves, and sand channels, are home to several algae, seagrass meadows, urchins, bi-valve clams, sponges and more.

MARO REEF

Maro Reef is the largest coral reef in the Northwestern Hawaiian Islands (NWHI), with over 1500 square km (approximately 600 square miles or 478,000 acres) of reef area. Unlike the classic ring-shaped atoll, Maro is a complex maze of linear reefs that radiate out from the center like the spokes of a wheel. A few large reef blocks cast up on the shallow northeastern reef crest can be sticking up out of the water, but are constantly washed over by wave action. Maro lacks any protective perimeter reef leaving this network of linear, patch and pinnacle reefs exposed to wave action from any direction.

Marine habitats of Maro Reef range from sandy lagoons to steep reef slopes, large coral heads, ocean pinnacles, and patch reefs. Gaps in the reef cause waves to sweep into the lagoon clouding some areas with silt and sand.

Despite its turbid water conditions which creates difficult study conditions, scientists have seen a greater abundance and diversity of coral here than most any other reef system in the NWHI chain. Many areas of the reef, particularly on the west side, have a large number of coral species, including *Montipora capitata* and finger coral *Porites compressa* that grow abundantly on the reef slopes. Maro Reef has a large amount of the hard, pink crusty algae that grows on coral called "coralline algae" that acts like cement and holds the coral together in high surf. The reefs support numerous butterflyfish and surgeonfish species. Large ulua and omilu have been seen in the reef's open waters, along with white-tip and grey reef sharks.

Some researchers believe that, while Maro Reef has very healthy reefs, it may be "on the verge of drowning" because the reefs are narrow, unconnected, and unprotected from storm waves. Others feel that the abundance and health of the corals suggest that Maro Reef will survive as a healthy reef.

LAYSAN ISLAND

Laysan is the second largest land mass in NWHI (1,015 acres), about 1 mile wide and 1-1/2 miles long and shaped like a poi board. It was formed from geologic forces pushing upward and by coral growth. It has fringing reefs and a hypersaline (very salty) lake in the middle of the island, the only lake in the island chain.

Surrounding the lake, the beautiful encircling white sand beach is topped by dry coastal grasses. Sedges grow thick near the lake's edge. Over 30 kinds of plants live on Laysan. In addition to the koloa, the Laysan duck is Hawai'i's "other" native duck species. This striking endemic duck has developed a fascinating eating habit: it runs on mud flats while snapping at swarms of brine flies to retrieve its meal.

Laysan has the fullest complement of all the bird species in the NWHI. Huge populations of seabirds nest and migratory shorebirds visit including Black-footed and Laysan albatross, Christmas and wedge-tailed shearwaters, and bristle-thighed curlews. Following the devegetation caused by rabbits, several land birds became extinct including the Laysan honeycreeper and millerbird, but two endemic land birds remain -- the hardy Laysan finch and Laysan duck. Of the 75 native invertebrate species found on Laysan, 15 are endemic.

Although the reef at Laysan is the smallest of the NWHI (145,334 acres), it is quite rich. Numerous sea turtles and monk seals appear on the island. Several species of Hawaiian surgeonfish and large schools of convict tangs are in the shallow, wave-washed waters around the island. Twenty-seven species of stony coral are reported, and branching corals are common.

Although a host of introduced species changed the "original fabric" of the island's ecology, this place has benefited from years of effort to "malama" (take care of) the island. The U.S. Fish and Wildlife Service set up a remote island camp in 1991 and have eliminated weeds and restored native vegetation. As a result, finch and duck populations are increasing. Laysan, the poster child for restorative island efforts, is considered one of the "crown jewels" of the NWHI.

KURE ATOLL

Kure Atoll is the most remote of the Northwest Hawaiian Islands, and the northernmost coral atoll in the world. Kure is a pronounced oval shaped atoll, which is 10 km at its maximum diameter and 91 km west-northwest of Midway Atoll at the extreme northwest end of the Hawaiian archipelago. Green Island (105 hectares) is the only permanent island in the atoll. Sand Island is a large sand bar system which varies in size with the seasons. The maximum elevation on Green Island is 8 meters.

In the 1960s, the U.S. government built a loran (navigation) station and a runway on Green Island, an islet of Kure. The loran station was later closed, after which the island was cleaned up and the tower and most of these structures taken down. Today, State employees live and work seasonally out of the remaining bunker type structures.

Despite its northern location and relatively cool waters, the aquatic habitats of Kure provide a diversity of corals and large invertebrates such as echinoderms, crustacea and mollusks. The turquoise waters of the lagoon and near-shore reefs support large schools of dolphins, jacks, sharks, goatfish, and chub, as well as dragon eels, knifejaws, masked angelfish and rare native grouper. Recent aquatic surveys have identified rare fish species and behaviors seldom seen in the main Hawaiian islands, raising additional questions about the effects of human activities on marine ecosystems.

The island is very important monk seal pupping area and a nesting area for shearwaters, petrels, tropicbirds, boobies, frigatebirds, albatrosses, terns and noddies. It is also a wintering area for a variety of migratory bird species from North America and Asia.

The atoll is lying at the gateway between the NWHI and the emperor seamounts.

GARDNER PINNACLES

When the two pinnacles of volcanic rock between French Frigate Shoals and Maro Reef come into view, mariners know they have reached Gardner Pinnacles. It is the last visible remnant of the chain's volcanic past.

Gardner Pinnacles is a collection of basalt pinnacles and emergent rocks. "Shorelines" are generally steep cliffs or ramps that descend steeply to depths of about 15m. A talus of large basalt slabs and block accumulate at the base of the pinnacles forming caves, rock piles and lean-tos that are important microhabitats for fish and invertebrates. Ledges and cliffs characterize the submerged base of the pinnacle and rocks above the talus.

This 5-acre island, with the smallest land area of any Northwestern Hawaiian Islands (NWHI), has 1,904 square kilometers (604,600 acres) of underwater shelves that extend out from the pinnacles, the most of any island or bank in the NWHI.

The pinnacles were first reported by Captain Joseph Allen of the Nantucket whaler, *Maro*, on June 2, 1820. He reported seeing "a new island or rock not laid down on any of our charts... it has two detached humps....we call it Gardner's Island."

Today, Gardner is known for its abundance of giant opihi, the endemic Hawaiian limpet. The islands' rocky inter-tidal areas are an ideal habitat for opihi. Coral species of many varieties are distributed throughout the pinnacles' reef system. Acropora table corals have been noted on the leeward side, while tube, stony, and soft corals have been found throughout the reef. Gardner Pinnacles' waters hold one of the highest numbers of fish species in the NWHI, including the red lip parrotfish, the doublebar goatfish, and the reef triggerfish.

Gardner is home to seabirds, insects, and only one species of plant, the succulent sea purslane (*Portulaca*). Scientists have observed 19 species of seabirds, 12 of which breed on the steep cliffs, including the rare blue gray noddy. Two species of migratory shorebirds, the ruddy turnstone and golden plover often stop over to rest or feed here as commonly noted on all the NWHI.

Despite its small size and isolation, the island has a surprisingly wide array of insects. Spiders, mites, moths, centipedes, flies, beetles, isopods and earwigs, among others, have been found on Gardner.

FRENCH FRIGATE SHOALS

French Frigate Shoals (FFS) is the largest atoll in Hawaii, consisting of a large, crescent-shaped reef. FFS is a good example of a classic atoll, formed on top of a volcano now submerged after millions of years of erosion, and surrounded by a well-developed coral reef. Numerous small, coral islets are found in the lagoon. In the northwestern section of the lagoon is a unique rock formation, a steep-sided tall basalt pinnacle (La Perouse) that juts out of the water and is the last remnant of the original volcano. While the land area is only $\frac{1}{4}$ square kilometer (67 acres), the total coral reef area of the shoals is over 744 square kilometers (232,000 acres). Marine habitats vary from exposed ocean-facing reefs to protected pockets surround by shallow linear reefs.

The shoals were used by the military during World War II. Tern Island, a part of the atoll, was formed into a runway to serve as a refueling stop for planes en route to Midway. From the air Tern Island looks like the shape of an aircraft carrier. The original seawall, runway, and some of the building structures remain on Tern Island and the U.S. Fish and Wildlife Service continues to maintain a field station there staffed year-round by two permanent employees and a handful of volunteers.

The FFS reef system supports the greatest variety of coral species in the NWHI, including the acropora table coral, finger coral, and stony coral. More than 600 species of invertebrates such as sponges, coral worms, snails, lobster, crabs, shrimp clams, oysters, sea urchins, and sea stars are found at FFS, including many endemic species. One area of the reef consists almost entirely of bivalve clams. More than 150 species of algae live among the reefs, including red, green and brown algae. The outer reef waters support gray reef sharks, butterfly fish, and large schools of jacks and groupers.

FFS also nurtures charismatic megafauna -- the green sea turtles and Hawaiian monk seals. More than 90% of the Hawaiian population of threatened green sea turtles, travel to the FFS for safe nesting. Satellite tagging of these turtles has indicated that most of them migrate to the Main Hawaiian Islands to feed and then return to breed at FFS. Some turtles travel northwest to feed, and others have traveled as far south as Johnston Atoll. The many small islets of FFS also attract the largest number of endangered Hawaiian monk seals in the NWHI. It is "their" place of refuge.