Let's Put Hawai'i on the Map!

Grade 4

`Ōhi'a Project / Exploring the Islands

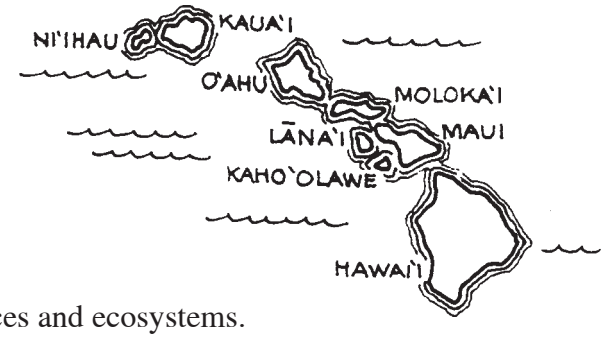
Essential Questions

- How does the subtropical location of the Hawaiian Islands and the surrounding ocean affect the islands' climate and weather?
- What causes the two seasons in Hawai'i each year?

Hawai'i D.O.E. Content Standards and Performance Indicators

Social Studies: World in Spatial Terms

- Show organization of collected data.
- Construct a map that includes collected geographic data.
- Explain the meanings, patterns and relationships found in the geographic data.



Social Studies: Physical Systems

- Explain the presence of climates, natural resources and ecosystems.
- Explain causal relationships between the physical processes of climate, natural resources and/or ecosystems.

Science: Doing Scientific Inquiry

- Design and conduct simple investigations to answer their questions and ideas about the environment.
- Collect and organize data for analysis, using simple tools and equipment.
- Use appropriate models to summarize data based on observations and findings.
- Communicate investigations and results appropriately to an audience.
- Defend conclusions based on evidence and revise conclusions as needed.

Science: Earth in the Solar System

- Compare and contrast rotation and revolution of the Earth.

Key Concepts

- The Hawaiian Islands are located in a subtropical, oceanic environment isolated from other large land masses.
- The warm, stable year-round climate of the Hawaiian Islands is due to subtropical latitude and the moderating effects of the surrounding ocean. These factors, and the Earth's annual revolution around the sun on its tilted axis, create the islands' two seasons: *ho'oilo* (the changeable, wet season; lit. to cause to sprout) and *kau wela* (the hot, dry season).

Activity at a Glance

Students create an islands' map and conduct a simple experiment to explore the factors affecting climate and weather in Hawai'i.

Exploring the Islands Telecast: "Lucky You Live in the Tropics"

Students from Pearl City Highlands Elementary School explore the clues to understanding climate and weather in the Hawaiian Islands. Students conduct an experiment to help them understand the moderating affect of the surrounding ocean, and they conduct a demonstration using Earth "balloons" to explore how the Earth's rotation on its tilted axis and its revolution around the sun create the islands' two seasons.

Assessment

Students:

- Produce maps of the Hawaiian Islands using latitude and longitude to place island cut-outs on a geographic grid.
- Complete a report on experiments that explains the question/problem, investigation design, observations/findings, and conclusion.
- Apply experiment conclusions to explain how the surrounding ocean affects the islands' climate and weather.
- Write summaries describing *kau wela* and *ho'oilo* and explain the factors that create these two seasons in the islands.

Time

five class periods

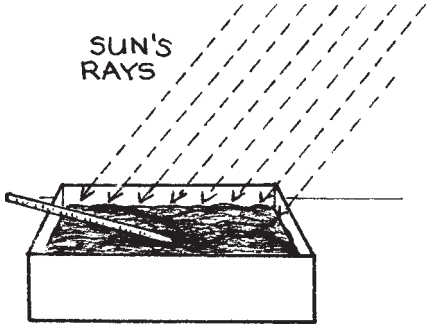
Materials/Resources

Hawaiian Islands map (provided)
student activity sheets 1 and 2 (provided)
glue and crayons or colored pencils
world map
globe and/or atlas

During the *Exploring the Islands* telecast:
heat lamp (if done indoors)

For each student:
light-colored balloon and a dark felt marking pen

For each group of four students:
two tin pans, one filled with soil and the other filled with water
two outdoor thermometers
data sheet and graph sheet (provided)
stopwatch (or watch/clock with a second hand)



Students compare the rate of temperature change between a pan of soil and a pan of water placed in the sun on Exploring the Islands.

Preparation

Duplicate the graph, data and activity sheets. Use sturdy paper for activity sheet 2 for students to cut out the island shapes. Assemble the materials needed for students' experiment during the telecast, and if desired, help them blow up the balloons and tie them before the program.

Vocabulary

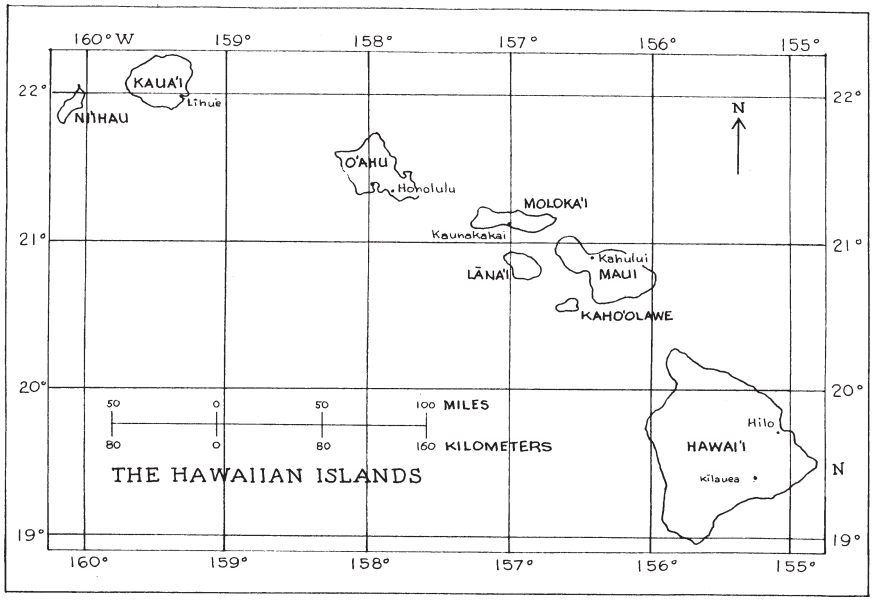
geographic grid, latitude, longitude, equator, degrees, scale, climate, weather, *ho'oilo*, *kau wela*, Tropic of Cancer, Tropic of Capricorn, tropics, tradewinds

Teacher Background Information

Location of the Hawaiian Islands

The Hawaiian Islands are the most isolated group of high islands in the world. They are located just below the **Tropic of Cancer** and are surrounded by the Pacific Ocean.

The **geographic grid** provides a system for pinpointing specific places on the Earth. People all over the world use this grid to establish locations. In a sense, it provides a universal "address" system. It is made up of horizontal lines called **parallels** of **latitude** (lat.) and vertical lines called **meridians** of **longitude** (long.).



Parallels of latitude are rings that run parallel to the **equator**. The parallels are distinguished from one another by **degrees** (°). These degrees are measured north and south of the equator, which is at lat. 0°. Hawai'i is at about lat. 21° N, and at the North Pole is at lat. 90° N. It is important to distinguish between north and south latitude.

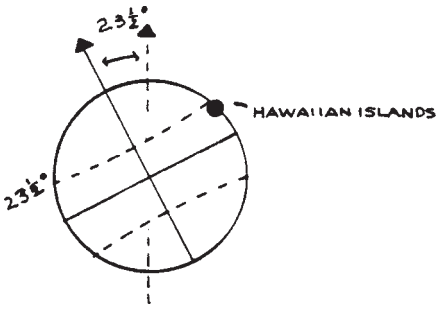
Meridians of longitude run from pole to pole. The meridian that passes through Greenwich, England is used as a baseline and is therefore at long. 0° (the prime meridian). East of Greenwich, meridians increase by degrees until they reach the other side of the world (somewhere west of Hawai'i) at 180°. Meridians on the half of the world east of Greenwich are labeled east longitude. Meridians on the half of the world west of Greenwich are labeled west longitude. Hawai'i is at about long 157° W.

To pinpoint specific locations, it us useful to break degrees into smaller units, since a degree near the equator is about 110 km (69 mi) wide! Each degree is divided into 60′ (**minutes**). Each minute is further divided into 60" (**seconds**). Thus, there are 60 x 60, or 360 seconds in each degree. Each place on the globe can be identified by its own latitude and longitude. For example, Hilo is at 19° 44′ N, 155° 52′ W; Honolulu is at 21° 20′ N, 157° 54′ W; and Līhu'e is at 21° 57′ N, 158° 22′ W.

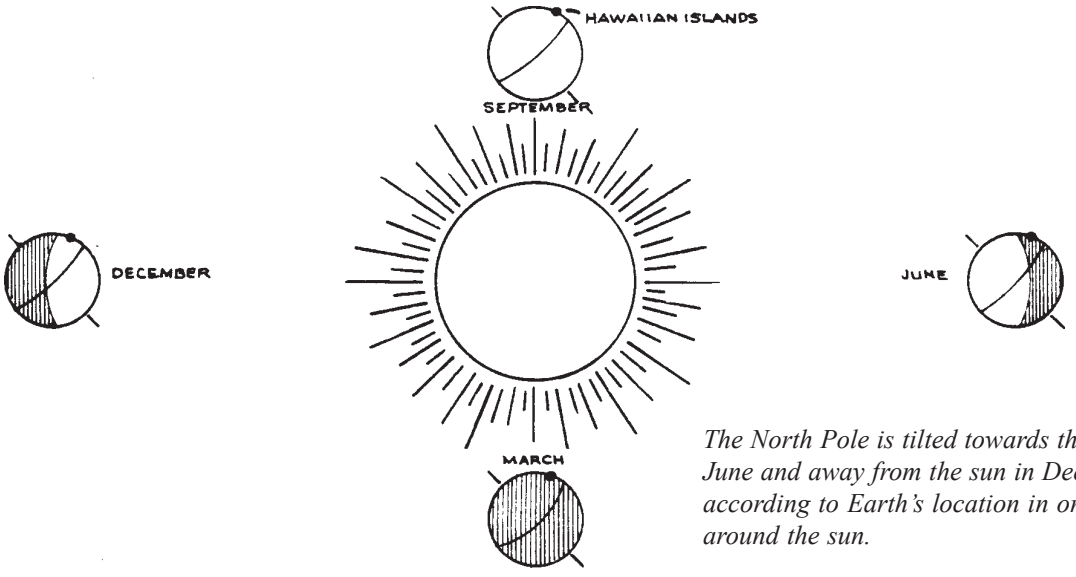
Other items found on most maps are a **compass rose** and a **scale**. The compass rose is used to indicate which direction is north. Sometimes, west, east and south are marked also. Most maps are oriented so that north is directly up.

Climate and Weather in Hawai'i: Latitude. We're in the Tropics

The subtropical location and the surrounding ocean create a relatively stable climate with a warm year-round growing season at low elevations in the Hawaiian Islands. At the latitude of the main islands, the sun passes directly overhead twice each year, in late May and in late July, as it moves to and from the Tropic of Cancer. In fact, for the rest of the year, the sun is never more that a 45-degree angle from being directly overhead at noon. Each day, the Earth makes one full rotation around its axis. The axis does not run straight up and down, but is tilted 23.5º relative to the sun. As the Earth orbits the sun, the equator receives constant exposure to solar energy. The Tropics of Cancer and Capricorn, at 23.5º north and south, respectively, mark the boundaries between tropical and temperate regions. At Hawai'i's subtropical latitude, the islands experience two seasons as the Earth revolves around the sun on its tilted axis: ***ho'oilo*** (the changeable, wet season; lit. to cause to sprout) from October through April; and ***kau wela*** (the hot, dry season) from May through September.



The Earth's north/south axis is tilted at an angle of 23.5º.



The North Pole is tilted towards the sun in June and away from the sun in December according to Earth's location in orbit around the sun.

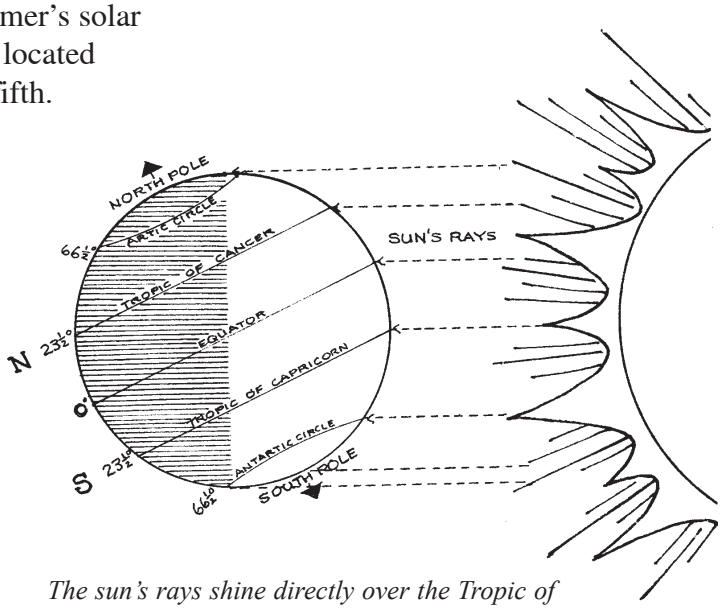
Because the Hawaiian Islands are just south of the Tropic of Cancer and not directly on the equator, they experience some shift in day length during the two seasons. Comparing the difference in time between longest and shortest days in cities at different latitudes illustrates the effect of latitude on day length.

City	North Latitude (degrees)	Longest Days** without twilight Hours	Min.	Shortest Days** without twilight Hours	Min.	Differences Hours	Min.
Anchorage	61	19	20	5	30	13	50
Seattle	48	16	0	8	20	7	40
Los Angeles	34	14	30	9	50	4	40
Honolulu	21	13	20	10	50	2	30

**In hours and minutes to the nearest 10 minutes
(Source: D. Blumenstock and S. Price, 1967, *Climates of the States: Hawaii*, National Weather Service.)

The farther north of the Tropic of Cancer or south of the **Tropic of Capricorn** a city is located, the less directly and intensely the sun shines on it.

During a clear day in the *ho'oilo* season, Honolulu receives at least two-thirds of the solar energy it receives on a clear summer's day during *kau wela*. A city located at latitude 40º would receive only one-third of its summer's solar energy during its winter day, and a city located at latitude 50º would receive only one-fifth. Imagine how you would feel and what you would do if the sun were shining at 11:00 p.m. or if it were dark for months at a time as it is in Anchorage, Alaska.



The sun's rays shine directly over the Tropic of Capricorn in the southern hemisphere during the northern hemisphere's longest winter day.

Climate and Weather in Hawai'i: Surrounding Ocean, Our Pacific Air Conditioner

Land absorbs and loses heat from the sun much faster than water does. The Hawaiian Islands are surrounded by the vast Pacific Ocean. The islands are more than

3,200 km (2,000 mi) from the nearest continental land mass, and almost one-half of the islands' area is within 5 miles of the coast. The ocean has a tremendous influence on the climate of Hawai'i.

The warmest month in Hawai'i is not June/July, when the days are longest and the sun's rays are direct. The coolest month is not December when the days are shortest and the sun's rays are slanted. The warmest month in Honolulu is August (average temperature 78.4° F) and the coolest month is February (average temperature 71.9° F). If the amount of daylight and the angle of the sun's rays cause the temperatures to rise and fall, why are there these delays?

The delays in cooling and heating our air temperature occur because of the time it takes the sun to warm up the ocean. Large bodies of water, such as the Pacific Ocean, heat up in summer and cool down in winter much more slowly than large land masses. There are several reasons for this. First, land surfaces are usually opaque. The sun's rays reach a rock, building, or a tree and penetrate no further. The ocean is not as opaque, so a ray of sunlight reaching its surface will spread its energy through several meters of water. Furthermore, the ocean has a shiny surface that reflects some of the sun's rays. In addition, land surfaces tend to remain stable, so the sun only warms the top layer. The ocean, on the other hand, is constantly churning and mixing. No sooner does the sun heat one layer than it is replaced by cooler water from below, so there is much larger area and volume to be heated.

The ocean has the effect of moderating the air temperature, keeping it warmer for a longer period of time, by warming the winds that blow across the water onto the land. In December, when the land is receiving its smallest amount of solar energy, the ocean is still warm enough to keep the air temperature up. It is not until about February, when the ocean is at its coolest, that the air temperature drops.

Land absorbs and loses heat from the sun much faster than water does.

The ocean helps keep temperature range of Hawai'i—the differences between the highest and the lowest temperatures—very narrow. The temperatures of the ocean's surface around the islands vary only about 6° F, from a low of about 73° F in late February and March to a high of near 80° F in late September or early October. The even ocean temperatures keep our air temperatures stable. There is only an average of 6.5° F difference between Honolulu's temperature in February and its temperature in August. In fact, there is more difference between day and night temperatures in the tropics than there is in daytime temperatures during summer and winter. There is a saying the "night is the winter of the topics."

Teaching Suggestions

1. Ask students to imagine they are caught in a ferocious storm at sea, with tattered sails and no motor. When they call for help on the radio they cannot describe where they are since there is no land in sight. What will save them? Perhaps the geographic grid, which can give them an address even way out at sea! (Sailors use Global Positioning System [GPS] equipment using satellites, or sextants, very precise clocks, and longitude tables to determine their latitude and longitude.)

2. Use a world map or globe to introduce students to latitude and longitude. Point out the compass rose and scale, the equator, and the tropics. Help students locate their town and other well-known points. Ask them to identify the latitude and longitude of a few places.

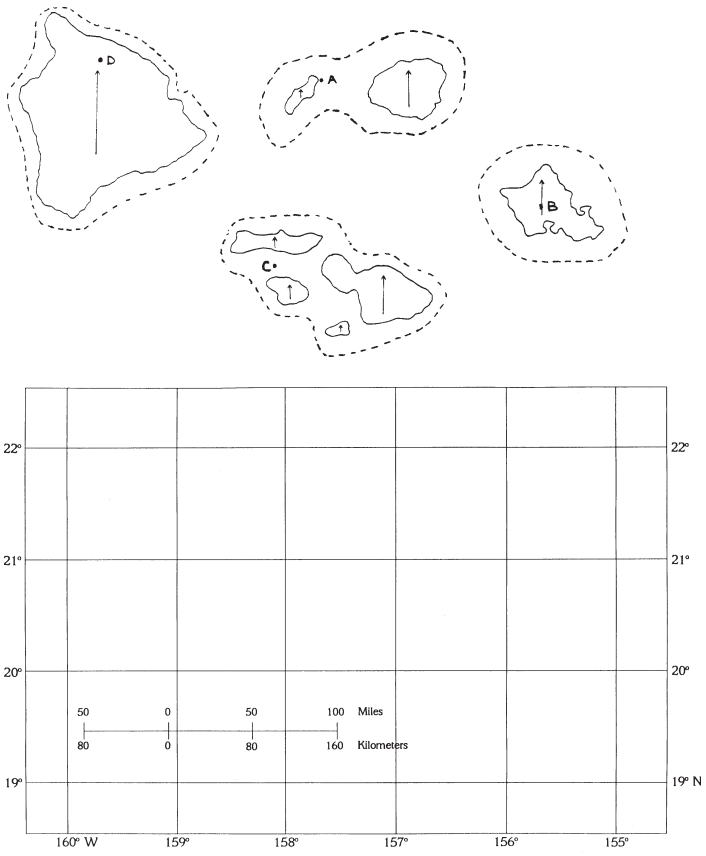
3. Distribute the student activity sheets and have students cut out the islands and place them on the grid (without glue) using the coordinates provided. Challenge them to do this without looking at a Hawaiian Islands map.

4. Distribute copies of the Hawaiian Islands map or project it.

5. Have students refer to the islands map, check their map for accuracy, and glue the cut-outs onto their grids. If desired, they could color each island. Help them find the general location of their school on the map, and mark it with a star and label.

6. Ask students to use the map and a world map to answer the questions on the activity sheet.

7. Conduct a discussion on mapping and climate using the questions on the student activity sheet and those below.



Students place cutouts of the Islands onto the geographic grid using coordinates given (student activity sheets 1 and 2).

Discussion Questions

- Compare the location of Hawai‘i and Alaska in terms of latitude and longitude. (Hawai‘i is in the tropics between 19–23º N and 155–160º W. Alaska is mostly between 60–75º N and 142–165º W.)

- Hawai‘i has a warm climate with wet and dry seasons and day length varying by only one or two hours between seasons. Alaska has extreme temperatures in summer and winter and day length varying (in the Arctic Circle) from 24 hours of darkness in winter to 24 hours of light in summer. Why are there these differences between the two locations? (Day length and seasonal temperatures vary because of the latitudes of these different locations on Earth as it revolves around the sun on its tilted axis.)

8. Distribute the activity sheets and materials students will need for *Exploring the Islands* and watch the telecast. Refer to the box on the following page for more information about the telecast.

9. Have students complete the assessment activities, completing their maps and activity sheets summarizing their experiment, and writing a description of the factors affecting the islands' two seasons.

Extended Activities

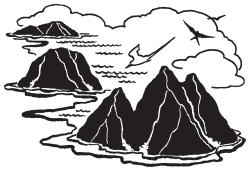
- Have pairs or groups of students use maps, globes or atlases to find the latitude and longitude of well-known locations on the planet, predict how location would affect temperatures and seasons in these locations, and then do research on the locations to determine their climate and seasons. The results of this research should be shared with the class. Students' presentations should incorporate models, diagrams, maps and demonstrations that were used in this activity.

- Plot the Polynesian Triangle on a grid of longitude and latitude laid out with surveyors tape in the schoolyard and plot islands on the grid. Conduct an activity that compares high islands with atolls. Identify which islands are atolls and which islands are high islands and then research climate and weather of these locales. Identify the factors contributing to climate and weather in these areas including terrain and the location of high pressure systems, the doldrums and storm tracks.

- Tune into weather bulletins of the National Weather Service to track the progress of storms moving to Hawai‘i on a graph of longitude and latitude. Ask students to reflect on the following: Why is it important for scientists who track hurricanes to understand weather conditions? How important is it that we know when a hurricane is coming and how fast its wind speed is? Why should the students know more about hurricanes?

- Challenge students to write a journal of an imaginary journey taken 1,000 years ago to find a new home with an ideal environment for living and growing food. Consider what conditions would contribute to such an ideal environment and where in the Pacific such a place could exist. (How ideal is the place where you live!?)

During the *Exploring the Islands* Telecast "Lucky You Live in the Tropics"



Mystery Minute Question for this week

On a tilted globe you'll find I get intense sunshine half the time.
Constellations have lent names to my boundaries' dotted veins. What am I?

MindPower Minute Questions

- How would seasons be affected if Earth were not tilted on its axis?
- Which city has more moderate temperatures throughout the year, San Francisco or Kansas City? Why?

Student Activities

Use balloons as "Earth" models and draw equator, N. Pole, S. Pole, Tropics of Cancer and Capricorn and location of Hawaiian Islands. Demonstrate tilt of axis and revolution around the sun.

Teams of students conduct an experiment to determine which heats up faster—soil or water. Results of the experiment are used to describe the affect of the ocean on the climate of Hawai'i. (See Materials/Resources and have them ready if you are watching the program on tape, which can be paused to allow time to set up and conduct the experiment. Otherwise, plan to conduct the experiment prior to watching the program.)

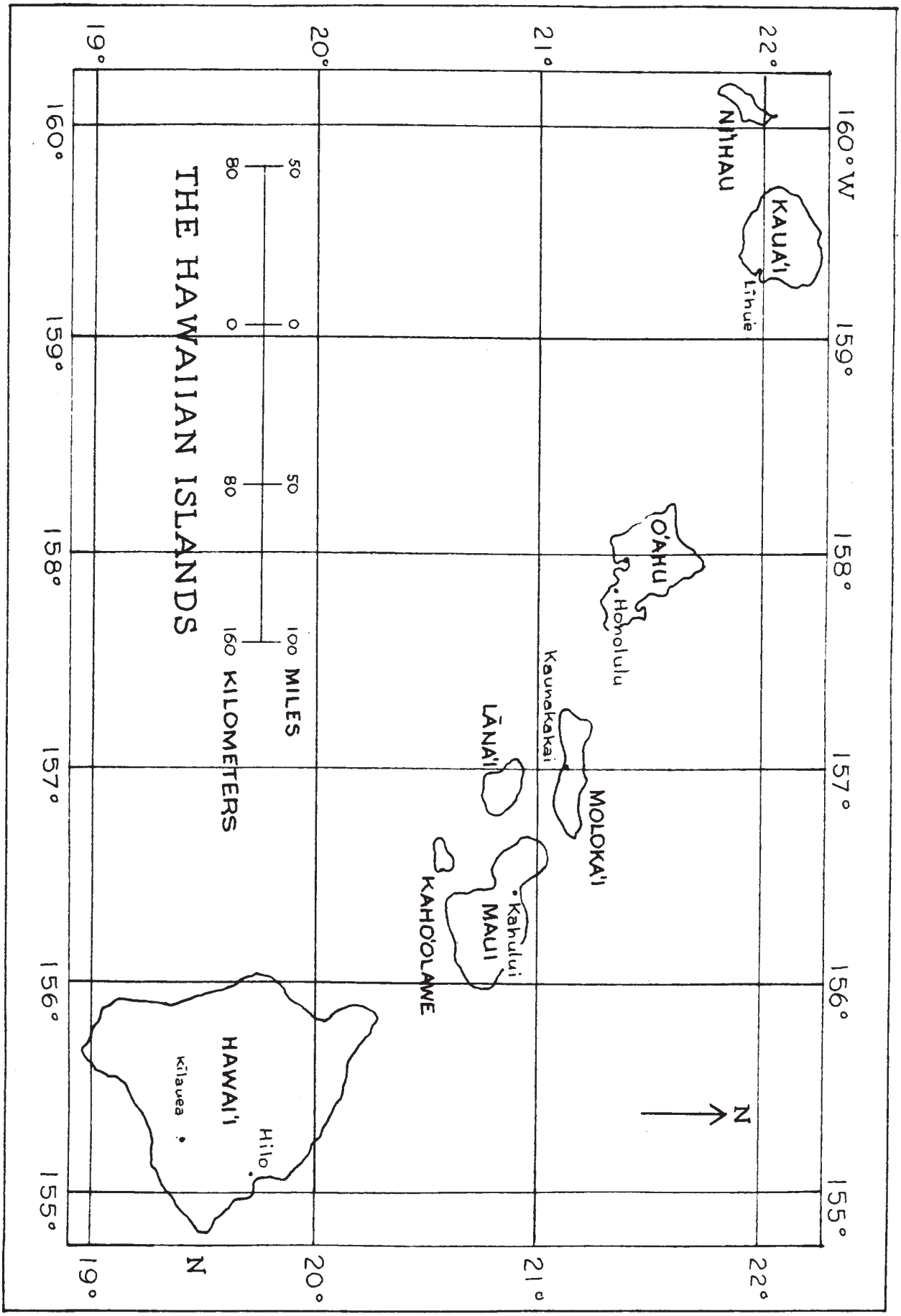
Conducting the experiment:

- Fill two identical baking pans, one with soil and one with water.
- Submerge the end of an outdoor thermometer in the soil and in the water. Secure with tape if needed.
- Place the pans in sunshine when sun is high overhead or use a heat lamp.
- Record the temperatures at regular intervals at least five times, e.g., every 10 minutes for 50 minutes (see data sheet provided).
- Place the pans in a cool air-conditioned room and continue to record the temperatures.
- Graph results and write conclusions.

Note that the soil should absorb and lose heat more quickly and, because there is so much more water in the ocean, the ocean takes even longer to change temperature than the water in the pan.

Mahalo to . . .

Pearl City Highlands Elementary School for assisting with *Exploring the Islands*!
Teachers: Karen Ching-Hew, Amy Sakai
Students: Brandon Chang, Kaci Cole, Taryn Takiguchi, Shawn Trinidad


THE HAWAIIAN ISLANDS
NI'IHAU
KAUA'I
Līhuè
O'AHU
Honolulu
Kaunakakai
LĀNA'I
MOLOKA'I
Kahului
MAUI
KAHO'OLAWE
HAWAI'I
Kilauea
Hilo
N
50
80
0
50
80
0
100 MILES
160 KILOMETERS
160° W
159°
158°
157°
156°
155°
22°
21°
20°
19°
N

Put Hawai'i on the map by cutting out the island shapes on activity sheet 2 and placing them on the geographic grid. Use the coordinates given to help you. Do not look at the Hawaiian Islands map until you have tried placing all of the islands. Then check the map before you glue the islands to the grid. Label each island.

Answer the following questions:

1. What is the approximate latitude and longitude of your town?

2. Using the scale provided, approximately how many kilometers (or miles) is it from Hilo to Līhu'e?

Use a world map to find out:

3. Where are the Hawaiian Islands in relationship to the equator? Which islands in the Pacific are closest to the equator?

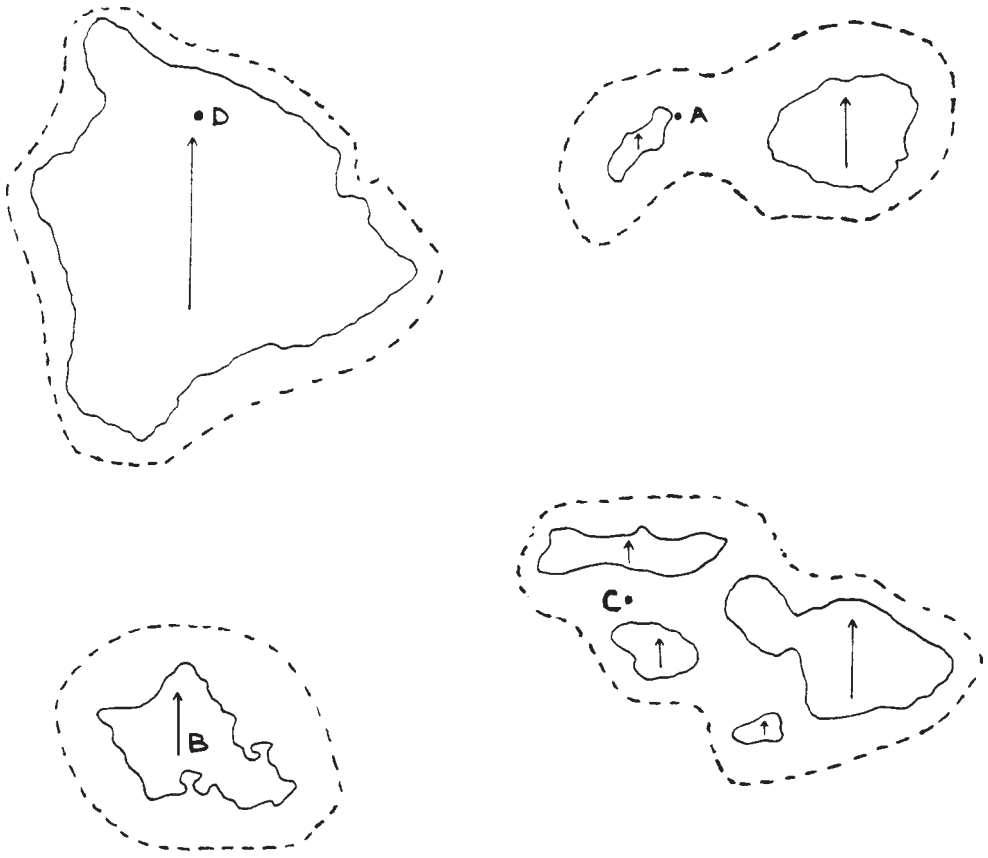
4. Identify other countries that are located in the tropics at the same latitude as Hawai'i but on the other side of the globe.

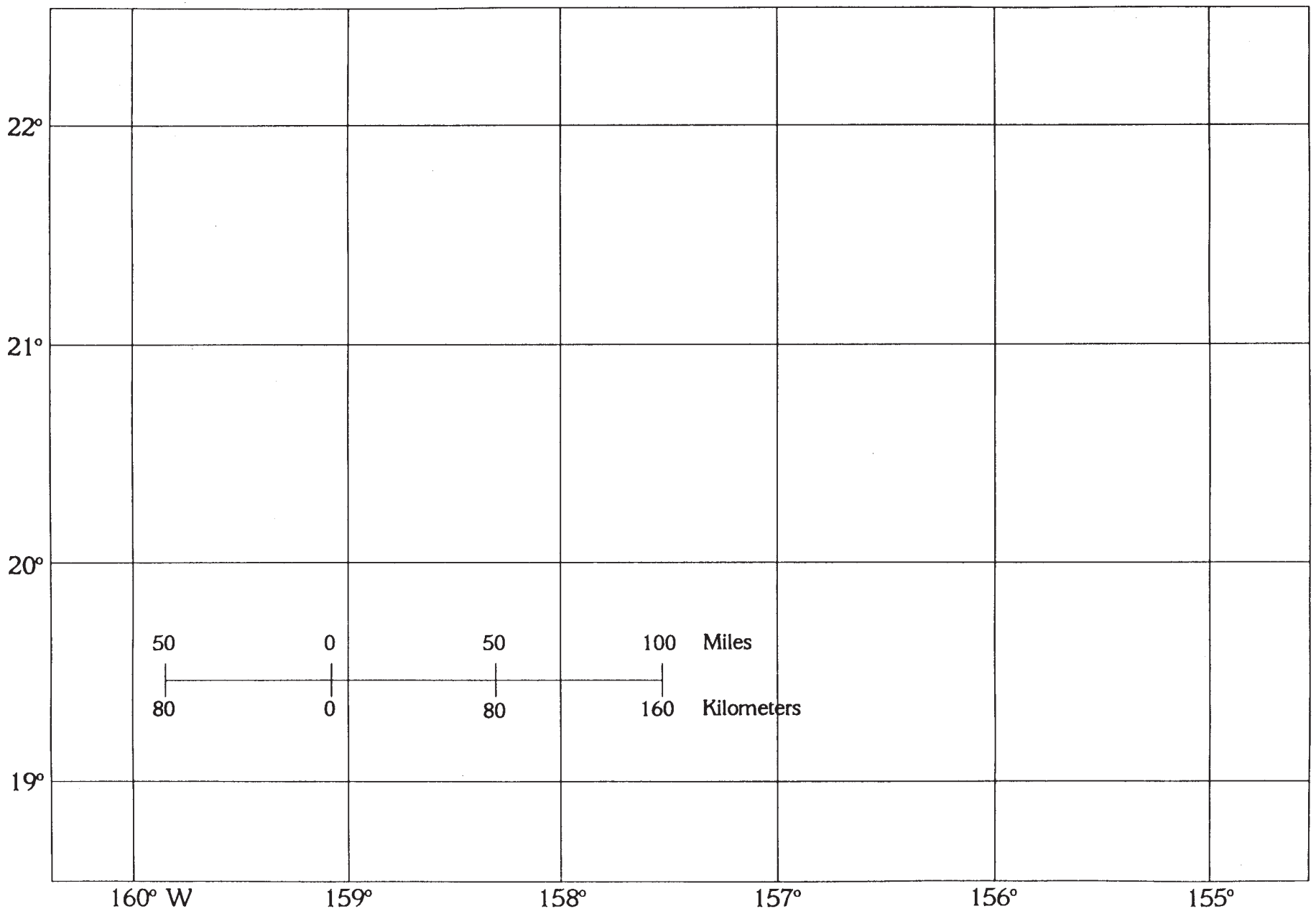
5. Which islands are the most isolated group of high islands in the world?

6. Which continents are nearest to Hawai'i? Approximately how far away are they?

7. Use the following words in a sentence or sentences describing the location of Hawai'i: tropics, isolated, Pacific Ocean.

Clues:
A. 22° N, 160° W
B. 21° 30′ N, 158° W
C. 21° N, 157° W
D. 20° N, 155° 30′ W





Your name: _____ Date: _____

Your research question: _____

Method: _____

Data

Time (min.)	Temp. deg. F		Notes
	Soil	Water	

Results: Use the Graph Sheet provided to make a graph of your results.

Conclusions: _____

_____

_____

Your name: _____

Date: _____

Title of Graph: _____