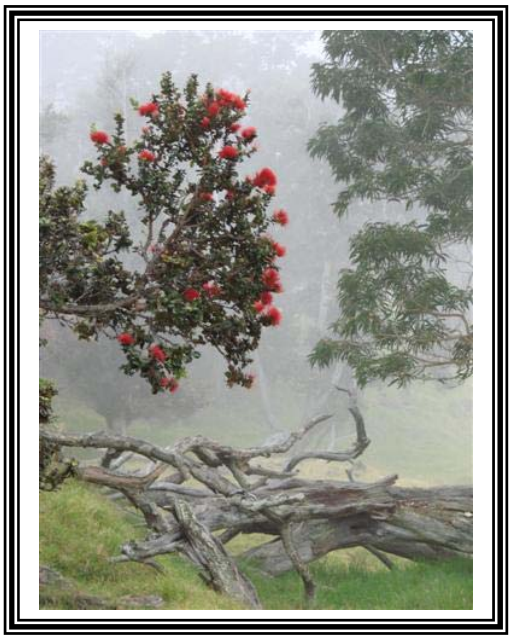
Kahuku Connections: Linking Science to the Past
A Global Positioning System (GPS) Exploration
Grades 9-12








‘Ukuli‘i kapua o Kahuku, onaona i ka mau‘u. Tiny is the flower of Kahuku, yet it scents the surrounding grasses.

Kahuku is a sprawling natural wonder of lava flows and endemic forests which shelter rare and endangered plants. The park protects these vital links to the past, remnants of prehistoric Hawaiian culture that date back 700 years.

Photo Analysis

Group activity:

This activity requires inquiry and reasoning skills. Use your best collaborative thinking.

As a group select four photos. Briefly describe each photo you have selected to identify what you see. Now, write a question about each one that captures the essence of this special place (not just what you see). Keep in mind that Kahuku is a vast landscape rich in natural and human history. Its majestic beauty also presents ecological challenges. Finally, formulate a speculative answer for the question you posed.

Example: Display Photo of "Calves Resting"

What we see in the photo are three calves resting; two black and white and one red and white.

Why are these calves present in a national park?

Kahuku has a long paniolo history and remains a working ranch that will be phased out in 2009. The 2,000 head of cattle are owned by Kahuā Ranch who in 2003 acquired a special use permit from the national park service. These organic lawn mowers help to suppress the high-fire fuel load of grasses and woody plants like Christmas Berry and Guava as resource managers replace areas with native plants. The national park service is not in the ranching business.

1.

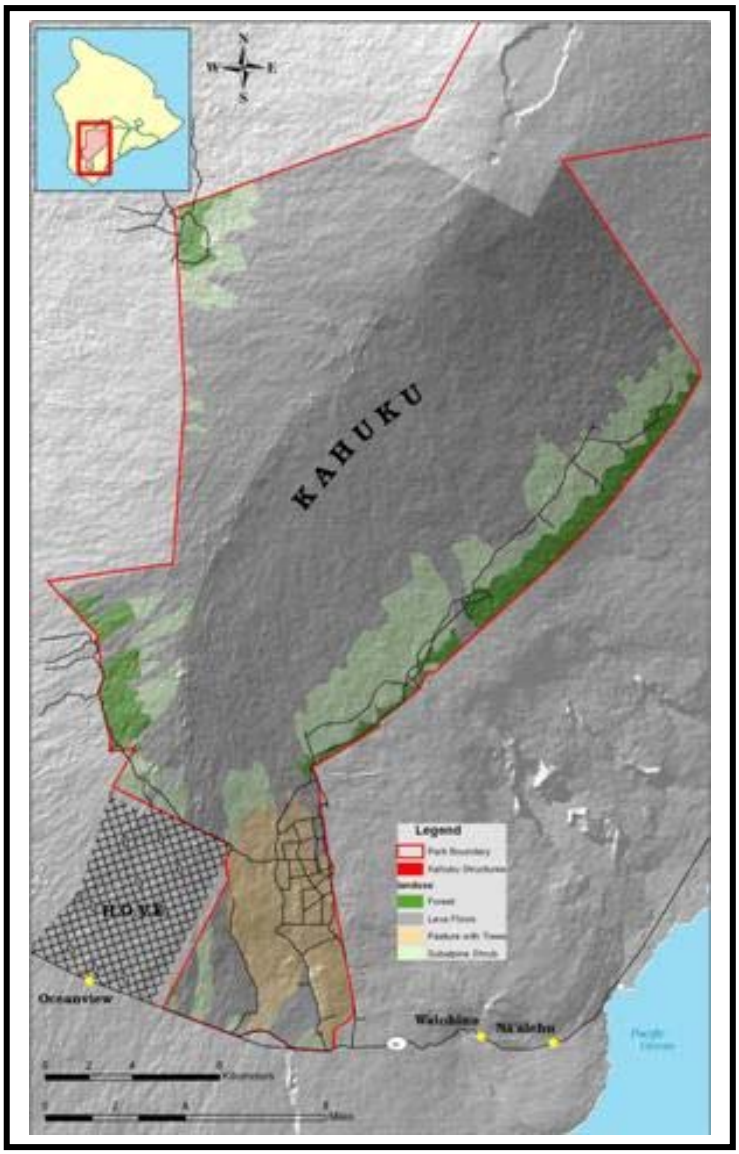
2.

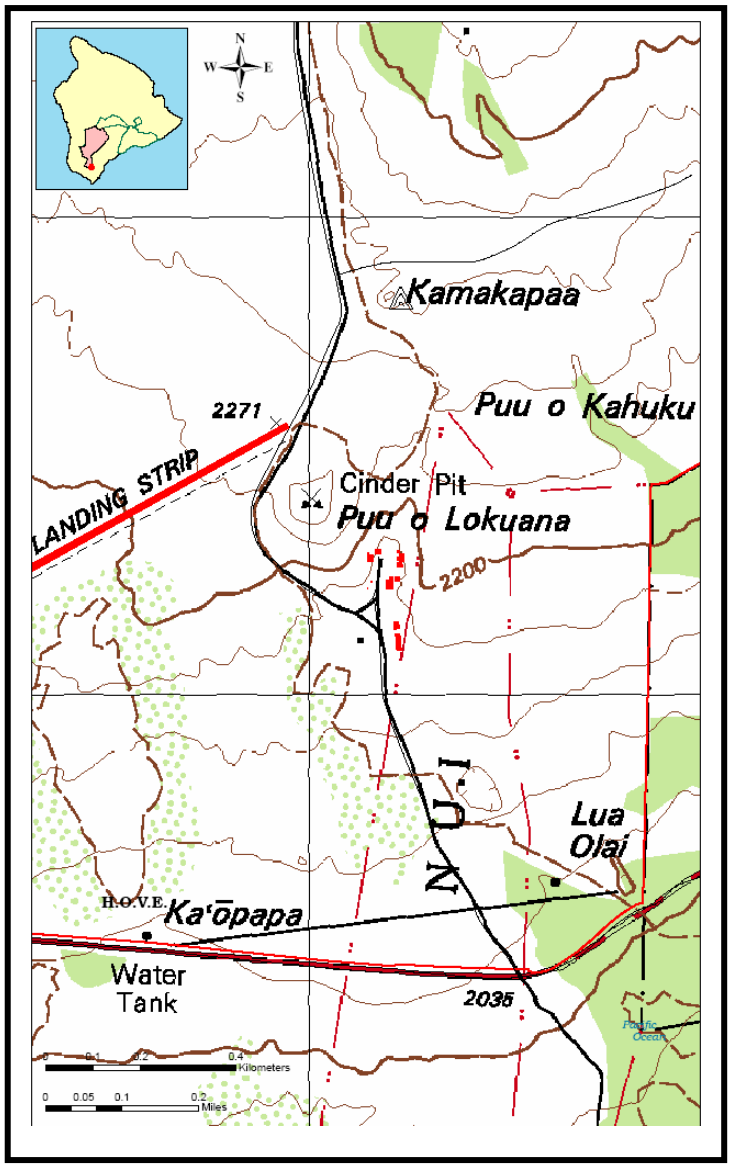
3.

4.

Setting the Stage and Locating the Site

Have you ever been lost? What were your first thoughts? Where am I and what is the easiest way back? Because Kahuku is such a diverse and undeveloped vast area, it's not always easy to find your way around this 116,000 acre national park unit. This is where map skills and GPS make a connection. Understanding basic mapping concepts and skills will help you find your way.





Look at the two maps and answer the following questions.

What color is the park boundary? Red

What is the purpose of the small island map in the top left hand corner? Inset map shows location and land area of the park.

What is located at the 2200 foot elevation? Landing Strip and Pu'u o Lokuana.

Estimate in miles the distance from the Water Tank to Kamakapaa? _____.85___miles

How are these two maps alike and different? **Difference**-One aerial, one topographic, only one with legend.
Similarities-Scale, compass rose, inset map, roads, forest areas

Which map shows elevation? The one on the right

Determining the Facts

Polynesians used a system that is known as **Wayfinding** to chart their destination. The complex task of Polynesian navigation depended on keen observations. Using this method they navigated throughout the vast Pacific Ocean without navigational instruments and found their way to Hawai‘i. Through the inspiration of these ancient wayfarers and others that followed, GPS technology was born.

Traditional Wayfinding-By Ocean

What is Wayfinding? Non-Instrument Navigating

How did they do it? Wayfinding involves navigating on the open ocean without sextant, compass, clock, radio reports, or satellites reports. The wayfinder depends on observations of the stars, the sun, the ocean swells, and other signs of nature for clues to direction and location of a vessel at sea. Wayfinding was used for voyaging for thousands of years before the invention of European navigational instruments.

In the 20th century, it is still practiced in some areas of Micronesia, although the traditional knowledge and techniques are in danger of being lost because of modernization and Westernization of the cultures of these areas. However, a revival of the art and science of wayfinding is underway among the Pacific islands, a revival led by Nainoa Thompson, the first modern-day Polynesian to learn and use wayfinding for long-distance, open-ocean voyaging. Thompson studied wayfinding under Mau Piailug, a master navigator from the island of Satawal in Micronesia. Mau navigated the first voyage of the Hokule'a to Tahiti in 1976; Thompson was Hokule'a's wayfinder on the 1980 and 1985-87 voyages.

A voyage undertaken using wayfinding has three components:

1. Setting up a course strategy, which includes a reference course for reaching the vicinity of one's destination, hopefully upwind, so that the canoe can make an easy downwind sail to the destination rather than having to tack into the wind to get there; (Tacking involves sailing back and forth as close as possible into the wind to make progress against the wind; it is very arduous and time-consuming, something to be avoided if at all possible. Psychologically and physically, it would be very difficult for the crew to face the most demanding part of the voyage at the very end.)

2. Trying to hold this course while keeping track of one's position in relationship to it during the voyage.

3. Finding land after reaching the vicinity of one's destination.

To Learn More… www.pbs.org/wayfinders/wayfinding

Navigating from One *Ahupua‘a* (land division from the mountain to the ocean) **to Another.**

Mo‘o‘ōlelo, stories, ‘ōlelo no‘eau, proverb, ‘Oli, chant, mele, song, and hula, dance describe landforms and environmental conditions to identify specific locations. These stories, songs, dances, chants and proverb were not only descriptive of a specific place, but many times playful.

Hele ho‘i ke ‘ala mauka o Ka‘ū (chant), Travel to the upland of Ka‘ū.

‘Auhea wale ‘oe Mauna Loa la, kīkālā nui (song), Where are you Mauna Loa, big hips?

He ‘a‘ali‘i kū makani mai au; ‘a‘ohe makani nana e kula‘i. I am a wind resisting ‘a‘ali‘i; no gale can push me over. (proverb) The people of Ka‘ū were liken to the ‘a‘ali‘i, able to hold their own through difficult times.

Ka nani a‘o Ka‘ū (song), The beauty that is Ka‘ū.

‘O Ka‘ū i ka makani, ka makani Kuehu Lepo (song), Ka‘ū in the wind, the dust-raising wind. Kuehu Lepo is the name of a wind of Nā‘ālehu (volcanic ashes).

Global Positioning System

What is GPS? Global Positioning System. A constellation of 27 Earth-orbiting satellites (24 in operation and 3 in case one fails to operate).

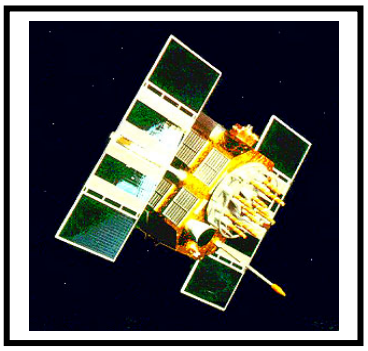
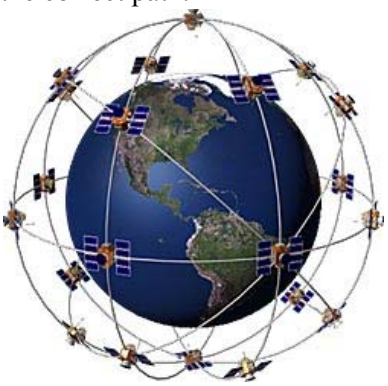


Photo Courtesy NASA
NAVSTAR GPS Satellite

How does the GPS satellite system work?

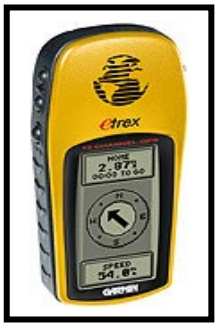
The 24 satellites that make up the GPS space segment are orbiting the earth about 12,000 miles above us. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are traveling at speeds of roughly 7,000 miles an hour.

GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path.



GPS Satellite System

What does a GPS receiver do?



A GPS receiver operates on information gathered from satellites to pinpoint locations. To locate itself, the receiver must find the distance to at least three satellites from known positions and the distance between you and each of those satellites. Using data collected, the receiver can provide latitude and longitude information and the elevation of your location. A standard GPS receiver will not only place you on a map but will also trace your path across a map as you move.

Where is a GPS receiver most effective? Open areas. The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects like buildings and mountains.

Is GPS 100% accurate? No
Why? Position error can range from tens of meters (recreational) to a few millimeters (survey) depending on equipment, signals and usage.

Here are some other interesting facts about the GPS satellites (also called NAVSTAR, the official U.S. Department of Defense name for GPS): The first GPS satellite was launched in 1978. A full constellation of 24 satellites was achieved in 1994. Each satellite is built to last about 10 years. Replacements are constantly being built and launched into orbit. A GPS satellite weighs approximately 2,000 pounds and is about 17 feet across with the solar panels extended. Transmitter power is only 50 watts or less.