

'Ike Pono Hawai'i

Ke Pānānā Hawai'i - The Hawaiian Star Compass

Objectives:

Students will:

- Learn the 32 houses of the Hawaiian Star Compass.
- Understand how cultural tools, artifacts, and practices can change over time.
- Understand how the Hawaiian values are essential to successfully finding islands.

Hawai'i Content Standards:

Content Area: Social Studies Grade: 4 Quarter: 3 Unit: 2 Lesson: 2

Standard 6: Cultural Anthropology: SYSTEMS, DYNAMICS AND INQUIRY

Understand culture as a system of beliefs, knowledge and practices shared by a group and understand how cultural systems change over time.

Big Idea(s) / Major Understanding (s): Students will understand that ...

Cultural change and continuity can be seen and understood through primary and secondary resources.

HCPS III Benchmarks:

4.6.1 Cultural Systems and Practices

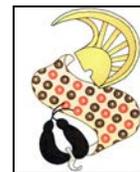
Explain how language, traditional lore, music, dance, artifacts, traditional practices, beliefs, values and behaviors are elements of culture and contribute to the preservation of culture.

4.6.3 Cultural Dynamics / Change and Continuity

Describe the changes in Hawaiian culture through contact with Westerners.

Nā Honua Maui Ola Guidelines:

1. Incorporate cultural traditions, language, history, and values in meaningful holistic processes to nourish the emotional, physical, mental/ intellectual, social, and spiritual well-being of the learning community that promote healthy *mauli* (life spirit) and *mana*



'Ike Pono Hawai'i

(power bestowed directly or indirectly from a supernatural source; an inherent quality of command and leadership; authority).

2. Maintain practices that perpetuate Hawaiian heritage, traditions and language to nurture one's *mauli* and perpetuate the success of the whole learning community.
3. Sustain respect for the integrity of one's own cultural knowledge and provide meaningful opportunities to make new connections among other knowledge systems.

Activity at a Glance:

Students will participate in a group activity learning the star house names for the 32 points on the Hawaiian Star Compass. They will also see a comparison of various types of compasses and how they have changed from the late 1800s until today. Interwoven within their group work and activities, students will be given an opportunity to apply the Hawaiian values of *hilina'i*, *laulima*, and *mālama*.

Assessment:

Hawaiian Star Compass Houses and Quadrants worksheet
Changes Over Time Student Reflection (Follow-Up activity)

Time:

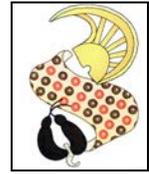
One hour

Materials Needed:

1. Hawaiian Star Compass model or graphic
2. Micronesian Star Compass model or graphic
3. Various star compass visuals for comparisons
4. Visual of 1905 Compass – Ke Pānānā Mua Loa ma ka 'Ōlelo Hawai'i
5. Hawaiian newspaper excerpts (one per student)
6. Star house and quadrant name placards or tent cards (36)
7. 1 / 2 inch two prong fastener for each student
8. Manu and small star compass printed on cardstock (one per student)
9. Students will need a pencil, colored markers and a scissors.

Student Handouts:

1. Nā Hua'ōlelo Hou - New Vocabulary
2. Ke Panana Mua Loa ma ka Olelo Hawaii
3. Hawaiian Star Compass Houses and Quadrants
4. Star House Mo'olelo



'Ike Pono Hawai'i

5. Changes Over Time Student Reflection Activity
6. Manu and small star compass on cardstock

Vocabulary:

'āina - land
'ākau - north
haka - empty
hema - south
hikina – east
ho'olua – NW quadrant
komohana – west
kona – SW quadrant
ko'olau – NE quadrant
lā – day, sun
malanai – SE quadrant
manu - bird
nā leo – the voices
nālani – the heavens
noio – a noddy tern
pānānā - compass

Teacher Background:

(Information modified and taken from the Polynesian Voyaging Society website – www.pvs.hawaii.org)

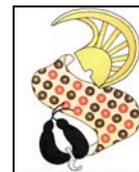
To help a person orient a voyaging canoe to the rising and setting points of stars, the wayfinder uses a **star compass** with thirty-two equidistant directional points around the horizon, each point 11.25 degrees from the next point (11.25 degrees x 32 points = 360 degrees). Each point is the midpoint of a house of the same name, and each house is 11.25 degrees wide (11.25 degrees x 32 houses = 360 degrees).

FOUR CARDINAL DIRECTIONS:

The four cardinal directions have traditional Hawaiian names:

East is called Hikina ("Arriving" or "Coming"), where the sun and stars "arrive" at the horizon;

West is called Komohana ("Entering"), where the sun and stars "enter" into the horizon;



'Ike Pono Hawai'i

North is called 'Ākau;

South is called Hema.

The four cardinal directional points divide the circle of the horizon into four quadrants, which have been given names associated with wind directions:

FOUR QUADRANTS:

Ko'olau is the NE quadrant, named for the windward side of the islands, the direction from which the NE trades, the most constant of the Hawaiian winds, blow.

Malanai is the SE quadrant, named for "a gentle breeze" (PE) associated with Kailua O'ahu (SE part of the island) and Koloa, Kaua'i (S by E part of the island); on a wind map of Pukapuka, two "Malangai" winds blow from the SE.

Kona is the SW quadrant, named for the leeward side of the islands, away from the NE trades; winds blowing from the south or SW are called kona.

Ho'olua is the NW quadrant, named for a strong north wind, generated by storm systems passing north of the islands. (The Pukui-Elbert dictionary gives Kiu as the name of a northwesterly wind.)

Each quadrant contains seven directional points and houses with the following names. The names were devised by Nainoa Thompson, the first Hawaiian in over 500 years to practice long-distance, open-ocean navigation without instruments:

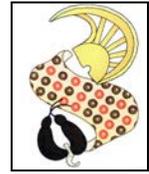
STAR COMPASS HOUSE NAMES (7):

Lā: "Sun"; the sun stays in this house for most of the year as it moves back and forth between its southern limit at the Tropic of Capricorn (23.5 degrees S) at Winter Solstice to its northern limit at the Tropic of Cancer (23.5 degrees N) at Summer Solstice.

'Āina: "Land"; This house between 17 degrees and 28 degrees on the horizon from east and west can be remembered because Hawai'i ('Āina, or Land) is at 21 degrees N latitude and Tahiti ('Āina, or Land) is at 18 degrees S latitude.

Noio: named for the Hawaiian tern, which helps a navigator find islands because it flies out to sea in the morning to fish (range about 40 miles) and returns to land at night to rest.

Manu: "Bird"; the four houses of Manu, midway between the four cardinal directions, can be seen as the points of the beak, tail, and outstretched wing-tips of a bird; the bird is the



Ike Pono Hawaii

traditional Polynesian metaphor for the canoe. On early voyages to Tahiti, the Hokule'a sailed in the direction of Manu Malanai, with its wings and Manu Ko'olau and Manu Kona, and its tail pointed back at Manu Ho'olua.

Nālani: Named for the brightest star in this house, Ke ali'i o kona i ka lewa (Canopus), which rises in Nālani Malanai and sets in Nālani Kona.

Nā Leo: "The Voices," referring to the voices of the stars speaking to the wayfinder.

Haka: "Empty"; named for the relatively empty skies around the north and south celestial poles; Kamakau say the names of these areas are Uliuli ("deep, dark blue") and Lipo ("deep, dark night").

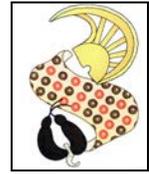
(Information about the name of these houses is from Will Kyselka's Ocean in Mind 96-97).

Seven directional houses in each of the four quadrants combine to give 28 compass directions between the four cardinal points:

Lā Ko'olau = E by N
'Āina Ko'olau = ENE
Noio Ko'olau = NE by E
Manu Ko'olau = NE
Nālani Ko'olau = NE by N
Nā Leo Ko'olau = NNE
Haka Ko'olau = N by E

Lā Ho'olua = W by N
'Āina Ho'olua = WNW
Noio Ho'olua = NW by W
Manu Ho'olua = NW
Nālani Ho'olua = NW by N
Nā Leo Ho'olua = NNW
Haka Ho'olua = N by W

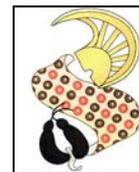
Lā Malanai = E by S
'Āina Malanai = ESE
Noio Malanai = SE by E
Manu Malanai = SE
Nālani Malanai = SE by S
Nā Leo Malanai = SSE
Haka Malanai = S by E



'Ike Pono Hawai'i

Lā Kona = W by S
'Āina Kona = WSW
Noio Kona = SW by W
Manu Kona = SW
Nālanī Kona = SW by S
Nā Leo Kona = SSW
Haka Kona = S by W

A star that rises in a house on the NE horizon travels across the sky, and sets in a house of the same name on the NW horizon; A star that rises in a house on the SE horizon travels across the sky, and sets in a house of the same name on the SW horizon. Thus, the rising and setting points of stars are clues to direction. Recognizing a star as it rises or sets and knowing the house it rises or sets in gives you a directional point by which you can orient the canoe and head in the direction you want to go. Ocean swells, also used to hold a course, travel from one house on the horizon to a house directly opposite on the horizon (180 degrees away), passing under the canoe, which is always at the center of the compass.



'Ike Pono Hawai'i

ADDITIONAL WAYFINDING READINGS
Taken from Polynesian Voyaging Society Website (www.pvs.hawaii.org)

Wayfinding, or Non-Instrument Navigation

Dennis Kawaharada

(Photo below: Swells Help a Navigator Hold a Course in the Daytime)

Introduction

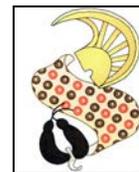
Before the invention of the compass, sextant and clocks, or more recently, the satellite-dependant Global Positioning System (GPS), Polynesians navigated open ocean voyages without instruments, through careful observation of natural signs. (See "[Hawaiians as Seaman and Navigators](#)".)

Navigator Nainoa Thompson of the Polynesian Voyaging Society, who was taught by Mau Piailug, a master navigator from Satawal in Micronesia, explains how a star compass is used to tell direction without instruments: "[The](#)



[star compass](#) is the basic mental construct for navigation. We have Hawaiian names for the houses of the stars-the places where they come out of the ocean and go back into the ocean. If you can identify the stars, and if you have memorized where they come up and go down, you can find your direction. The star compass is also used to read the flight path of birds and the direction of waves. It does everything. It is a mental construct to help you memorize what you need to know to navigate.

"How do we tell direction? We use the best clues that we have. We use the sun when it is low on the horizon. Mau has names for how wide and for the different colors of the sun path on the water. When the sun is low, the path is tight; when the sun is high it gets wider and wider. When the sun gets too high you cannot tell where it has risen. You have to use other clues.



'Ike Pono Hawai'i

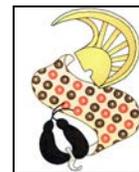
"Sunrise is the most important part of the day. At sunrise you start to look at the shape of the ocean-the character of the sea. You memorize where the wind is coming from. The wind generates the swells. You determine the direction of the swells, and when the sun gets too high, you steer by them. And then at sunset we repeat the observations. The sun goes down-you look at the shape of the waves. Did the wind change? Did the swell pattern change? At night we use the stars. We use about 220 stars by name-having memorized where they come up, where they go down.

"When I came back from my first voyage as a student navigator from Tahiti to Hawaii the night before he went home, Mau took me into his bedroom and said "I am very proud of my student. You have done well for yourself and your people." He was very happy that he was going home. He said, "Everything you need to see is in the ocean but it will take you twenty more years to see it." That was after I had just sailed 7000 miles.

"When it gets cloudy and you can't use the sun or the stars all you can do is rely on the ocean waves. That's why he said to me, "If you can read the ocean, you will never be lost." One of the problems is that when the sky gets black at night under heavy clouds you cannot see the swells. You cannot even see the bow of the canoe. And that is where people like Mau are so skilled. He can be inside the hull of the canoe and just feel the different swell patterns moving under the canoe and he can tell the canoe's direction lying down inside the hull of the canoe. I can't do that. I think that's what he learned when he was a child with his grandfather.

"The Southern Cross is really important to us. It looks like a kite. These two stars in the Southern Cross always point south (Gacrux on top and Acrux on the bottom). If you are traveling in a canoe and going south, these southern stars are going to appear to be traveling the higher and higher in the sky each night. If you went down to the South Pole, these stars are going to be way overhead. If you are going north to Hawai'i, the Southern Cross travels across the sky in a lower and lower arc each night. When you are at the latitude of Hawai'i, the distance from the top star (Gacrux) to the bottom star (Acrux) is the same distance from that bottom star to the horizon. That only occurs in the latitude of Hawai'i. If you are in Nuku Hiva at 9° S, the distance between the bottom star in the Southern Cross and the horizon is about nine times the distance between the two stars."

The following techniques are used by Hawaiian and Polynesian navigators taught by Mau and Nainoa. The art, as it is practiced today in Hawai'i, uses a Hawaiian star compass developed by Nainoa, incorporating principles from Mau's Micronesian star compass and traditional Hawaiian names for directions and winds.



'Ike Pono Hawai'i

The Sun

The sun is the main guide for the navigator without instruments. Twice a day, at sunrise and sunset, it gives a directional point to the traveler, as it rises in the east and sets in the west. The exact direction changes during the year. As the earth, tilted at 23.5° angle, orbits the sun, the sun appears to move in the sky against the background of the stars along a curving path called the ecliptic and through a series of 12 constellations called the zodiac. (See "The Ecliptic".) At the spring and fall equinoxes (Mar. 21 and Sept.23) the sun appears to be on the celestial equator and rises due east and sets due west. During the summer, the sun is north of the celestial equator, rising and setting north of east and west; at summer solstice (June 21), the sun rises 23.5° north of east ('Aina Ko'olau, or ENE) and sets 23.5° north of west ('Aina Ho'olua, or WNW). During the winter, the sun is south of the celestial equator, rising and setting south of east and west; at winter solstice (Dec. 22), the sun rises at 23.5° S of east ('Aina Malanai, or ESE), and sets 23.5° S of west in 'Aina Kona (WSW).

[Click here for a Diagram of the Rising and Setting Points of the Sun.](#)

To hold a course, the navigator aligns the rising or setting sun to marks on the railings of the canoe. There are 8 marks on each side of the canoe, each paired with a single point at the stern of the canoe, giving bearings in two directions, 32 bearings in all to match the 32 directional houses of the Hawaiian star compass.

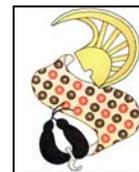
[Click here for a Diagram of the 32 Bearings Marked onto the Canoe Rails.](#)

The Stars

Like the sun, most stars rise in particular directions on the eastern horizon, travel across the sky, and set in particular directions on the western horizon. The directional house in which a star rises on the Hawaiian Star Compass has the same name as the house in which it sets (e.g., a star rising in 'Aina of the Ko'olau quadrant (ENE) sets in 'Aina of the Ho'olua quadrant (WNW). The directional point at which a star sets is at the same angular distance (declination) and in the same direction (i.e., north or south) from west as the house in which it rose is from east. For example, at the equator, Hokulei (Capella) rises at 46° N of east in Manu Ko'olau (NE) and sets at 46° N of west in Manu Ho'olua (NW).

[Click Here for the Rising Points of the 21 Brightest Stars.\)](#)

The navigator holds his course by orienting his canoe to these rising and setting points. For example, when the navigator with a favorable wind wants to head Manu Malanai (SE), and a star is rising at the point Manu Malanai (SE), he points the bow toward the star. If there is no star rising or setting in the direction he is heading, the navigator can orient the canoe using a star rising or setting anywhere else on the horizon, as long as he knows its direction. He keeps the star at a bearing that will head the canoe in the desired direction.



'Ike Pono Hawai'i

[Click here for a Diagram of Steering by the Stars.](#)

As wind drift may be carrying the canoe to the right or left of its apparent heading, the navigator corrects his steering for this sideway drift, called leeway; as the night passes and stars rise and set, moving about 1 degree across the celestial sphere every four minutes, the navigator uses as many stars as possible as clues to hold his direction.

If the star is above the horizon, the navigator imagines a line from it down to its rising or setting point. The angles at which the stars rise and set will change with latitude. Only at the equator do stars appear to rise perpendicular to the horizon. In Hawai'i, at 20° N, stars rise and set at a 20° angle, leaning south from straight up; in Tahiti, at 17° south, stars rise and set at a 17° angle, leaning north from straight up. In other words, the angle at which stars rise and set from a line perpendicular to the horizon is equal to the latitude of the observer. The pathways of the stars lean south in the northern hemisphere and north in the southern hemisphere.

As the navigator moves north or south of the equator, the rising and setting points will begin to shift north for stars north of east and west and south for stars south of east and west. The shift will be smaller for stars near the celestial equator, and greater for stars toward the north and south celestial poles. (This shifting is due to the changing angle of the curved surface of the earth over which the observer sees the sky.)

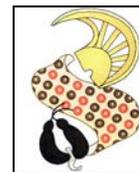
As the observer moves toward the poles, the angles of rising and setting of the stars will tilt closer and closer to the horizon until at the poles, the stars will not rise or set, but circle around the observer like figures on a merry-go-round, with the observer standing in the middle. At the north pole, only the northern half of the celestial sphere is visible; at the south pole, only the southern half of the celestial sphere is visible.

A star which angles as it arcs through the sky is useful for determining direction when it is within $30\text{-}35^{\circ}$ of the horizon; beyond this it becomes difficult to tell exactly where it rose or will set. At the equator, where stars rise perpendicular to the horizon, a star may be traced back to the horizon from a greater altitude.

During a voyage, stars may be available for navigation only about 20 percent of the time; daylight and cloud-cover at night hide them from the navigator during the other 80 percent of the time.

North and South Pointers

Pairs of stars that cross the meridian at the same time are oriented north and south. (The meridian is an imaginary line from due north to due south passing through the zenith, the point in the sky directly overhead; the meridian is perpendicular to the horizon; stars move from east to west through the sky and cross the meridian at the midpoint of their journeys from horizon to horizon.) Meridian pairs, or pointers, in the northern sky point north; pairs in the southern sky



'Ike Pono Hawai'i

stars point south. For example, the top and bottom stars in the Southern Cross, a meridian pair, point south when the Cross is upright.

Meridian Pointers to the North Celestial Pole

- Alpheratz (00h 8.4m) + Polo'ula / Caph (00h 9.2m)
- Alpha Trianguli (01h 53.1 m) + Segin (01h 54.4m)
- Theta Aurigae (05h 59.7m) + Menkalinan (05h 59.5m)
- Puana / Procyon (07h 39.3m) + Nanamua / Castor (07h 34.6 m) & Nanahope / Pollux (07h 45.3 m)
- Hikulua / Merak (11h 1.8 m) + Hikukahi / Dubhe (11h 3.7m)
- Cor Caroli (12h 56m) + Hikulima / Alioth (12h 54m)
- Ed Asich (15h 24.9m) + Pherkad (15h 20.7m)
- Gienah (20h 46.2m) + Pira'etea / Deneb (20h 41.4m)
- Markab (23h 2.8m) + Scheat (23h 3.8m)

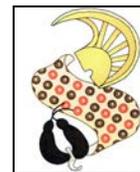
Meridian Pointers to the South Celestial Pole

- Mirzim (06h 27.7m) + Ke Ali'i o Kona i ka Lewa / Canopus (06h 23.9m)
- Suhail (09h 08m) + Star in the False Cross (09h 11m)
- Cross Dividers: Mu Velorum (10h 46.8m) + Unnamed star cluster (10h 46.3m)
- Hanaiakamalama / Southern Cross: Kaulia / Gacrux (12h 31.2m) + Ka Mole Honua / Acrux (12h 26.6m)
- Menkent (14h 6.7m) + Mailemua / Beta Centauri (14h 3.8m)
- Alpha Lupi (14h 41.9m) + Mailehope / Alpha Centauri (14h 39.6m)
- Top stars in Kamakau / Scorpio: Dschubba (16h 0.3m) + Pi Scorpii (15h 58.8m)
- Middle stars in Kamakau / Scorpio: Epsilon Scorpii (16h 50.2m) + Mu2 Scorpii (16h 52.3m) + Zeta Scorpii (16h 54.6m)
- Bottom stars in Kamakau: Kamaka / Shaula (17h 33.6m) + Sargas (17h 37.3m)

The Moon

Like the sun, the moon travels along the path called the ecliptic; however, it completes its cycle in 29.5 days—the time it takes for the moon to orbit the earth. (See "The Moon Along the Ecliptic.") The moon rises about 48 minutes later each night at a different position on the eastern horizon from where it rose the night before. Its rising point moves back and forth between 'Aina Ko'olau (ENE) and 'Aina Malanai (ESE) during its 29.5 day orbit around the earth; its setting point between 'Aina Ho'olua (WNW) and 'Aina Kona (WSW). As it changes its position in relationship to the sun and earth, it goes through 29-30 phases.

The Hawaiian Lunar Month



'Ike Pono Hawai'i

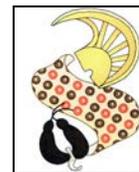
In the traditional Hawaiian calendar, the lunar month was determined by the 29.5-day cycles of mahina, the moon, and the passage of days was marked by the phases of the moon. The approximately 30 days of the moon cycle were divided into three 10-day periods (anahulu). The first 10-day period was called "ho'onui," "growing bigger."

1. Hilo (faint thread; cf. puahilo, "faint, wispy").
2. Hoaka (crescent; arch over the door; Handy and Handy say the name means "faint light" or "casting a shadow.")
- 3-4-5-6. **Kukahi, Kulua, Kukolu, Kupau** (Literally, First, Second, Third, and Last **Ku**)
- 7-8-9-10. 'Olek**u**kahi, 'Olek**u**lua, 'Olek**u**kolu, 'Olek**u**pau (Literally, First, Second, Third, and Last 'Olek**u**. 'Olek**u**lua was the first quarter of the moon; the names for days 7-10 match the names of days 21-24 of the last quarter moon; days 7-10 mark the transition from less than half-lit moon to the more than half-lit moon.)

The second 10-day period was called "poepoe," "round" or "full," when the moon appears full and round. The nights of the bright moon-possibly Akua, Hoku, and Mahe-a-lani- were referred to as "**na po mahina konane**"; **konane** means "bright moonlight."

11. Huna ("to hide"; when the moon hides its "horns" and appears more rounded)
12. Mohalu ("to unfold like a flower," "to blossom")
13. Hua (fruit, egg)
14. Akua (god; the first night of fullness)
15. Hoku (the second night of fullness; if the moon is still out at sunrise, it is called Hoku ili, "Stranded moon"; if it has set just before sunrise, it is called Hoku palemo, "sunken moon.")
16. **Mahe-a-lani** (the third night of fullness; "**mahea**" means "hazy, as moonlight")
17. **Kulua** (E.S. Craighill Handy, with Mary Kawena Pukui, gives this day name as "Kulu," which could mean "to drop" or "to pass, as time does")
- 18-19-20. La'auk**u**kahi; La'auk**u**lua; La'auk**u**pau (Literally, First, Second, and Last La'auk**u**; during this sequence, the sharp "horns" of the moon begin to appear again.)

The third 10-day period was called "'emi," "decreasing" or "waning." The moon begins to lose its light. The last quarter moon rises around midnight and sets around noon. Muku, the new moon, is unseen between the earth and the sun.



'Ike Pono Hawai'i

21-22-23. 'Olekukahi; 'Olekulua; 'Olekupau (Literally, First, Second, and Last 'Oleku; 'Olekulua was the last quarter; the names of days 21-23 match the names of 7-10 days of the first quarter moon, and mark the transition from more than half-lit moon to less than half-lit moon.);

24-25-26. Kaloakukahi; Kaloakulua; Kaloapau (Literally, First, Second, and Last Kaloaku;

27. Kane

28. Lono

29. Maui ("ghost," "spirit"; Malo: "fainting"; Kepelino: "last breath")

30. Muku ("Cut-off." The new moon; the end of the moon cycle. The moon is in front of the sun; its backside is lit; its front side, facing the earth, is dark.)

Determining the rising and setting points of the moon each night in relationship to another celestial body allows the moon to be used for navigation, day or night.

The line separating light and dark on the moon's surface is aligned approximately north and south since the moon is positioned east or west of the sun as they travel across the sky.

Hoku hele / "Traveling Stars" (Planets)

Planets ("Wanderers") appear to move among the fixed stars over time; hence, their Hawaiian names **hoku hele**, "Traveling Stars", or **hoku 'ae'a**, "Wandering Stars." Their rising and setting points can be determined from nearby stars; they can be used for navigation once their positions have been determined. The Hawaiian names for the visible planets are:

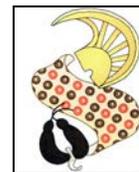
Mercury: Ukali'i ("Following the chief," i.e. the Sun)

Venus: **Hokuloa** ("Long Star"), **Hokuao** ("Morning Star"), **Hokuahiahi** ("Evening Star"), **Hokuali'i** ("Chiefly Star"), **Hokuali'iwahine** ("Chiefly [female] Star")

Mars: **Hoku'ula** ("Red Star"), **Holoholopina'au**, 'Aukelenuiaiku ("Great traveling swimmer, son of Iku")

Saturn: Makulu ("A drop of mist")

Jupiter: **Aohoku** ("Starlight"), 'Iao ("Dawn"), Ikaika ("Strong," "Powerful")



'Ike Pono Hawai'i

Ocean Swells

During midday and on cloudy nights when celestial bodies are not available at the horizon as directional clues, the navigator uses the wind and swells to hold a course. However, the direction of wind and swells cannot be determined independently; their direction can only be determined by reference to celestial bodies such as the rising or setting sun.

Swells are waves that have traveled beyond the wind systems or storms that have generated them, or waves that persist after the generating storm has died away. Swells are more regular and stable in their direction than waves. ("Waves," as opposed to "swells," are generated by local, contemporary winds.) Sometimes swells can be felt better than they can be seen, having flattened out after traveling long distances. In the Pacific, the northeast trade winds generate a northeast swell; the southeast trade winds create a southeast swell, and so on. Storms in the South Pacific during the Hawaiian summer generate a south swell; storms in the north Pacific during the Hawaiian winter generate a north swell.

Swells move in a straight line from one house on the star compass to a house of the same name on the opposite side of the horizon, 180 ° away. Thus, a swell from the direction of Manu Ko'olau (NE) will pass under the canoe and head in the direction of Manu Kona (SE); a swell from 'Aina Malanai (ESE) will pass under the canoe and head in the direction of 'Aina Ho'olua (WNW).

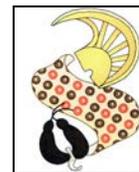
The navigator can orient the canoe to these swells. For example, if the canoe is heading SE Manu with a swell coming from the SE Manu, the person steering keeps the canoe headed directly into the swell, which lifts the bow, passes beneath, and then lifts the stern. If the canoe is traveling SW, a SE swell would roll the canoe from side to side, lifting first the port hull, then the starboard hull as it passes beneath. (See "[Steering by the Swells.](#)")

After the navigator orients the canoe to a swell pattern, he gets used to the pitching, rolling, or corkscrewing of the canoe; when the motion changes the navigator knows that the canoe is no longer going in the same direction (assuming the direction of the swell remains constant). The motion gets complex when more than one swell is running; an experienced traditional navigator like Mau can feel as many as four or five swells.

Swells may change direction after a time because the storm generating them may be moving. In places such as the doldrums, the swell pattern can be confused by waves generated by variable local winds from isolated and passing squalls. When the seas are confused, navigation by ocean swells is difficult.

Winds

The direction of the wind can be used to hold a course-the person steering simply holds the wind at a constant bearing to the canoe. However, the wind may change directions during the day (it is



'Ike Pono Hawai'i

less stable than swells), so the direction of the wind must be checked frequently against rising or setting celestial bodies and the ocean swells. ([See "An Account of Tahitian Navigation".](#))

Landmarks

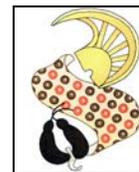
On coastal voyages, a navigator can steer by landmarks. Lining up two landmarks (e.g. a hill and a mountain) allows him to hold a straight line. Two pairs of landmarks allow him to find a spot, such as a deep-sea fishing ground, where the two lines intersect. One can also navigate by knowing the shape of reefs or underwater topography which can be seen from the surface. While leaving an island for the open ocean, the navigator back sights on the island, lining up two landmarks to hold his desired direction.

Seamarks

On the 1992 *Hokule'a* voyage from Hawai'i to Tahiti, Mau Piailug shared with navigator Shorty Bertelmann a seamark he had remembered from previous voyages along the route: Mau told Shorty to look for a school of porpoises; it would indicate that he had reached a point around 9 ° N latitude on the route to Tahiti. Bertelmann sighted the porpoises at around 9 ° N, confirming for him that he was on course and solidifying his faith in the traditions of Pacific navigation.

In Micronesia, these living seamarks are called "aimers" and are "purported to be associated with particular locales in the vicinity of islands or midway between them. They comprise such things as a tan shark making lazy movements, a ray with a red spot behind the eyes, a lone noisy bird, a swimming swordfish, and so on. Each of these phenomena has its own individual name and is located within a particular 'drag' on a particular star course from its associated island. on the long course from Puluwat to Eauripik there is said to be a row of whales, each situated a day's sail directly south of an island. Each whale has its own distinctive characteristic" (University of Pennsylvania).

Grimble notes that Gilbert Island navigators also have a tradition of seamarks: "As Europeans use landmarks, so the Gilbertese [navigators] uses seamarks to check their daily position. These signposts in mid-ocean consist of swarms of fish, flocks of birds, groups of driftwood, or conditions of wave and sky peculiar to certain zones of the sea. Hundreds of such traditional betia [seamarks] were stored up in the race memory as a result of cumulative experience of generations" (Grimble, *Tungaru Traditions* 48). These seamarks are found along routes between islands and indicate to the navigator that he was at a certain point along his route. For example, the seamark called "the swarming of beasts" consisted of an extraordinary number of sharks" and indicated the canoe was "a day's sail downwind of land." Other marks include a region where flying fish leaped in pairs, a zone of innumerable jellyfish, an area of numerous terns, an area of sharks and numerous red-tailed tropic birds, a place marked by a school of porpoises, a place where pairs of porpoises point their heads "in the direction of the passage into Tarawa lagoon" (*Tungaru Traditions* 49-50).



'Ike Pono Hawai'i

Signs of Landfall

Once the canoe is in the vicinity of its destination according to the navigator's dead reckoning and latitude measurements, the navigator starts looking for land.

Navigating without instruments is not a precise science. Poor weather and mental lapses on a long voyage adversely affect its accuracy. But the navigator need not sail to a destination with pinpoint accuracy to be successful. Instead, the navigator in the Pacific tries to hit a "screen" of islands, that is, a group of islands that stretches out on either side of his destination. The longer or wider the screen, the less likely the navigator will miss it. Islands in the Pacific are seldom isolated; they are usually found in clusters. The Tuamotu Archipelago stretches 550 miles north to south and 500 miles east to west; the Society Islands stretches 160 miles north to south and 310 miles east to west; the Hawaiian islands extend more than 1000 miles across the ocean east to west; the major islands form a north-south screen of about 240 miles.

While sailing to Tahiti from Hawai'i, the navigator can target a 400-mile wide screen of islands between Manihi in the western Tuamotus, and Maupiti in the eastern Society Islands. If the navigator can hit any one of the islands in this target screen, he can reorient the canoe after he identifies the island and determines its position in relationship to his destination; if he does not recognize the island and the island is inhabited, he can ask the islanders where he is and if possible, get directions to his destination.

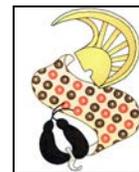
While there are open-ocean gaps between islands in a screen, a navigator looks for signs to let him know the proximity and direction of land even when he cannot see it. Signs of land include drifting land vegetation; clouds piled up over islands; the loom above an island created by sunlight or moonlight reflecting up from the white sand and smooth water of a lagoon; distinctive patterns of swells created by swells refracting around and / or reflecting off islands; and seabirds.

Land-Based Seabirds

Seabirds such as the manu-o-Ku (white tern) and the noio (noddy tern) go out to sea in the morning to feed on fish and return to land at night to rest.

The diurnal flights of such birds are the most useful signs for expanding landfall, since their flights to and from an island give a fairly specific direction to the navigator. As the birds leave an island in the morning, the navigator can sail in the direction the birds are coming from to find land; as the birds rise up from fishing and return to an island in the late afternoon, the navigator can follow the birds to land.

During nesting season, the habits of birds change. Nainoa Thompson tells this story about his first voyage to Tahiti in 1980-2400 miles navigated without instruments: "We saw two birds after the 29th day and I was extremely relieved. At least we were in the ball park. The birds rose



‘Ike Pono Hawai‘i

up high and flew away, and we sailed in that direction; at night we couldn't see the island so we took the sails down and waited. The next morning, we looked for the birds to see what direction they were coming from and that would be the direction of the island. We waited for the first bird. All hands on deck. Not a single bird. I began to worry-it was my first voyage, and I was unsure of myself. Mau Piauug was very calm and didn't say anything. We waited and we waited. The canoe was just sitting in the water, facing south. One of the canoe members was at the back of the canoe and a bird flies right over his head. The night before that we saw the birds flying south so how come late in the morning with the sun very high was this bird coming out of the north? That would suggest that we passed the island during the night. In my panic, I thought we had better start sailing back in that direction to find the island before the sun goes down again. We turned the canoe around. But when I started to sail north Mau, who has always said that his greatest honor would not be as a navigator but as a teacher, came to me and said, "No." It was the first time that he interrupted the trip. He said, "turn the canoe around and follow the bird." I was really puzzled. I didn't know why. He didn't tell me why. But we turned the canoe around and now we see other birds flying also. Mau said, "you wait one hour and you will find the island you are looking for." And after about an hour, Mau, who is about twenty years older than me-my eyes are physically much more powerful than his-he gets up on the rail of the canoe and says: "The island is right there." And we all stood up and we climbed the mast and everything and we just couldn't see it. Vision is not so much about what you do-but how you do it. It's experience. Mau had seen in the beak of the bird a little fish and he knew that the birds were nesting. They had flown out to sea before sunrise and were taking food back at mid-morning to feed their young, before they flew out to sea again to feed themselves."

A low atoll with coconut trees can be seen at sea from about 7 -10 miles away; observing the daily flight patterns of seabirds can indicate the direction of islands far out of the range of sight. Thompson gives the following estimates of ranges of two seabirds that are the most reliable indicators of land:

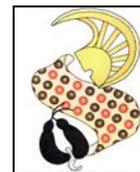
manu-o-Ku (fairy tern): 120 miles (though this bird may stay out at sea, or fly back to land unseen at night)

noio (noddy tern): 40 miles

Generally, sighting of large groups of birds are more reliable signs of islands than one or two birds stray birds or small groups. ([See "Locating Land."](#))

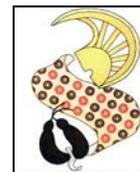
Instructional Procedures:

1. Review 'ōlelo no'ēau and Hawaiian value with students from Lesson 1.
2. Review three objectives covered in Lesson 1. Review cardinal directions on the Hawaiian Star Compass by starting off with the Hilina'i Activity from the previous day.



'Ike Pono Hawai'i

3. Introduce Lesson 2 objectives.
4. Discussion:
 - a. How would you feel if they were sailing on a canoe or cruising on a ship and the navigator did not know where he/she was going?
 - b. If you are a navigator, what are some important things for you to know?
 - c. Today, we'll be learning about the directions on the Hawaiian Star Compass, something that Hawaiian navigators need to know to reach their destinations.
5. Introduce the compass developed in 1905 (on the first page of the student handouts). Do a compare and contrast with the modern day Hawaiian Star Compass. Point out the similar words that refer to the directions students have already learned (i.e. hikina, komohana, 'ākau, and hema).
 - a. Distribute a copy of an excerpt taken from the Hawaiian newspaper "Ka Nupepa Kuokoa" Issue 11/17/1905.
 - b. Have students with a pen or highlighter, mark where they see the four cardinal directions ('ākau, hema, hikina and komohana) listed.
 - c. Share with students that even in 1905, such terms were being used. Explain to students that they will learn more about primary and secondary resources in Lesson 3.
6. Introduce the 28 points on the Hawaiian Star Compass.
7. Explain to students that stars have addresses just like we do today. Their address consists of one or two Hawaiian words (i.e. 'Āina Ko'olau). Distribute the handout "Star House Mo'olelo (Story)" to students.
8. Tell the story: *"Empty (Haka) are the Voices (Nā Leo) of the Heavens (Nā Lani). The Bird (Manu) Noio (Noio) helps the navigator to find Land ('Āina). Lā is the house where the sun rises and sets."*
9. Have students fill in the lines on their handout. Reinforce to them that if they remember this story, they will be able to remember the star compass house names.
10. Direct students to sit in a circle. Place star house name placards on the floor in its proper place around the circle. Share the illustration of the shape of a pizza. Instructor may draw on the classroom board if available. Cut the pizza into a half and then fourths. Share the names of the four quadrants (Ko'olau (NE), Malanai (SE), Kona (SW), and Ho'olua (NW)).
11. Explain and practice with students the names of the star houses (Haka, Nā Leo, Nālani, Manu, Noio, 'Āina, and Lā)

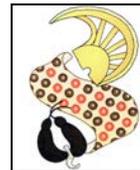


'Ike Pono Hawai'i

12. Activity: Rising and Setting of Stars.
 - a. Explain how stars appear to rise and set. Show the movement by use of an inflatable ball.
 - b. To illustrate their understanding of the rise/set movement, have students participate in tossing the inflatable ball to the rise/set house names.
 - c. Teacher to call out house names and students to respond by tossing the ball in the opposite house.
13. If time allows, compare the movement of the ocean currents on the star compass. Ocean currents move diagonally across the compass (i.e. NE to SW).
14. Introduce follow up activity to leave with teacher and students to complete. Show example of finished product.
15. Remind students to bring something personal that is representative of him/ or her or holds some value to them – a memento. They should write a short caption (2 – 4 sentences maximum) about the item on an index card.
 - a. Some examples:
 - i. Photos (or a copy of a photo)
 - ii. Awards
 - iii. Stories that were written by students
 - iv. Stories that were read by students
 - v. Sculptures
 - vi. Pieces of art
 - b. *Bring something that is not too fragile or rare. The memento they bring will be on display for all to see and/ or touch. If they feel that their article may get damaged, then they should not bring it.*

Follow-up Activities:

1. **Star Compass Bird cut out:** Hand out diagrams of small star compass and bird cut out. Have students color and cut their bird. Then, cut out the star compass. Teacher to distribute a ½ two prong fastener to each student. Have students attach these items with the prong to their completed Hawaiian Star Compass Houses and Quadrants Worksheet. The worksheet will help the students to recall the directional houses on the Hawaiian star compass.
2. **Student Reflection Activity:** Have students choose an item that has changed over time (Hawaiian or Western influence). Write a two paragraph paper on what the item is, what it has become. Also, compare and contrast the changes or transformations it has gone through.



'Ike Pono Hawai'i

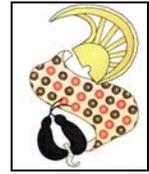
3. **Student test review:** "Hökūle'a vs. Hawai'iloa Challenge" Develop questions regarding the star compass so that students can remember the star house names. Repetition is good. Divide classroom into two teams. Instruct team members to send one representative to the board. Teacher to ask question. The first team to write and spell correctly the answer on the board is the winner. Selected representative to keep a running tally on which team wins after each question.

Additional Resources:

"Ke Panana Mua Loa ma ka Olelo Hawaii" Ka Nupepa Kuokoa. 17 Nov. 1905.

Website: www.pvs.hawaii.org "Hawaiian Star Compass.", "Wayfinding – Non-Instrument Navigation." The Polynesian Voyaging Society, 1993.

Yadao, Elisa. "Daily Living aboard the Hökūle'a." Education Kit: Navigating Change. Hawai'i: PREL, State of Hawai'i Department of Education, Department of Land and Natural Resources, NOAA, U.S., Fish & Wildlife Services, and Bishop Museum.



'Ike Pono Hawai'i

Ke Pānānā Hawai'i – The Hawaiian Star Compass

'Ōlelo No'eau - Hawaiian Proverbs or Wise Sayings

Mai ka ho'oku'i i ka hālāwai lā.
From zenith to horizon.

He waiwai Hawai'i - A Hawaiian value

Hilina'i – Trust

Nā Hua'ōlelo Hou – New Vocabulary

'āina – land

'ākau – north

haka – empty

hema – south

hikina – east

ho'olua – NW quadrant

komohana – west

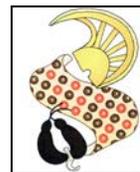
kona – SW quadrant

ko'olau – NE quadrant

lā – day, sun

malanai – SE quadrant

manu – bird



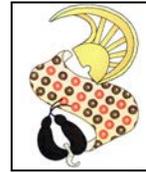
'Ike Pono Hawai'i

nā leo – the voices

nā lani – the heavens

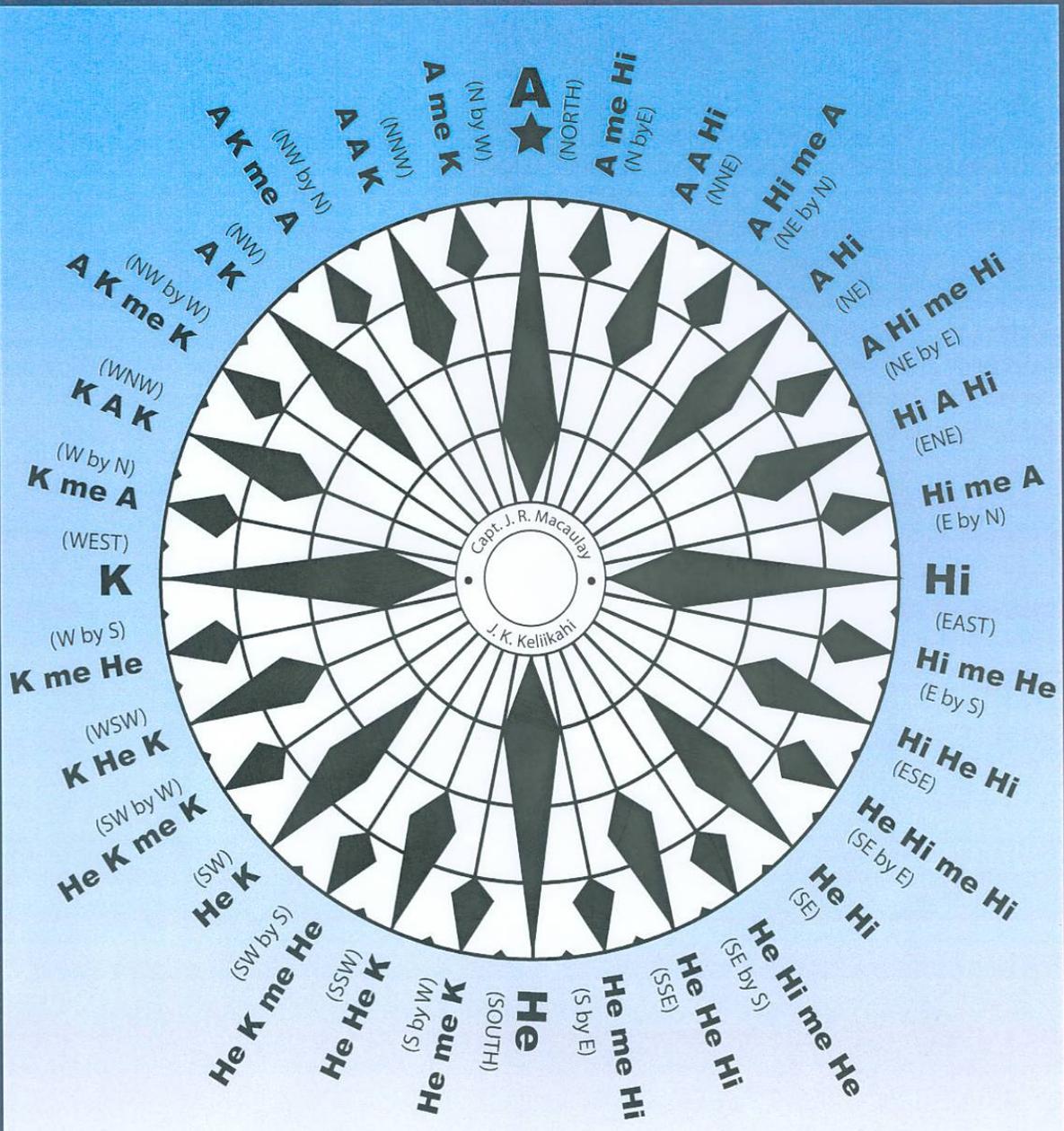
noio – a noddy tern

pānānā - compass



'Ike Pono Hawai'i

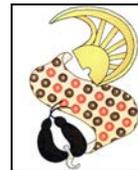
Ke Panana Mua Loa ma ka Olelo Hawaii



Source: Nupepa Kuokoa, 17 November 1905.

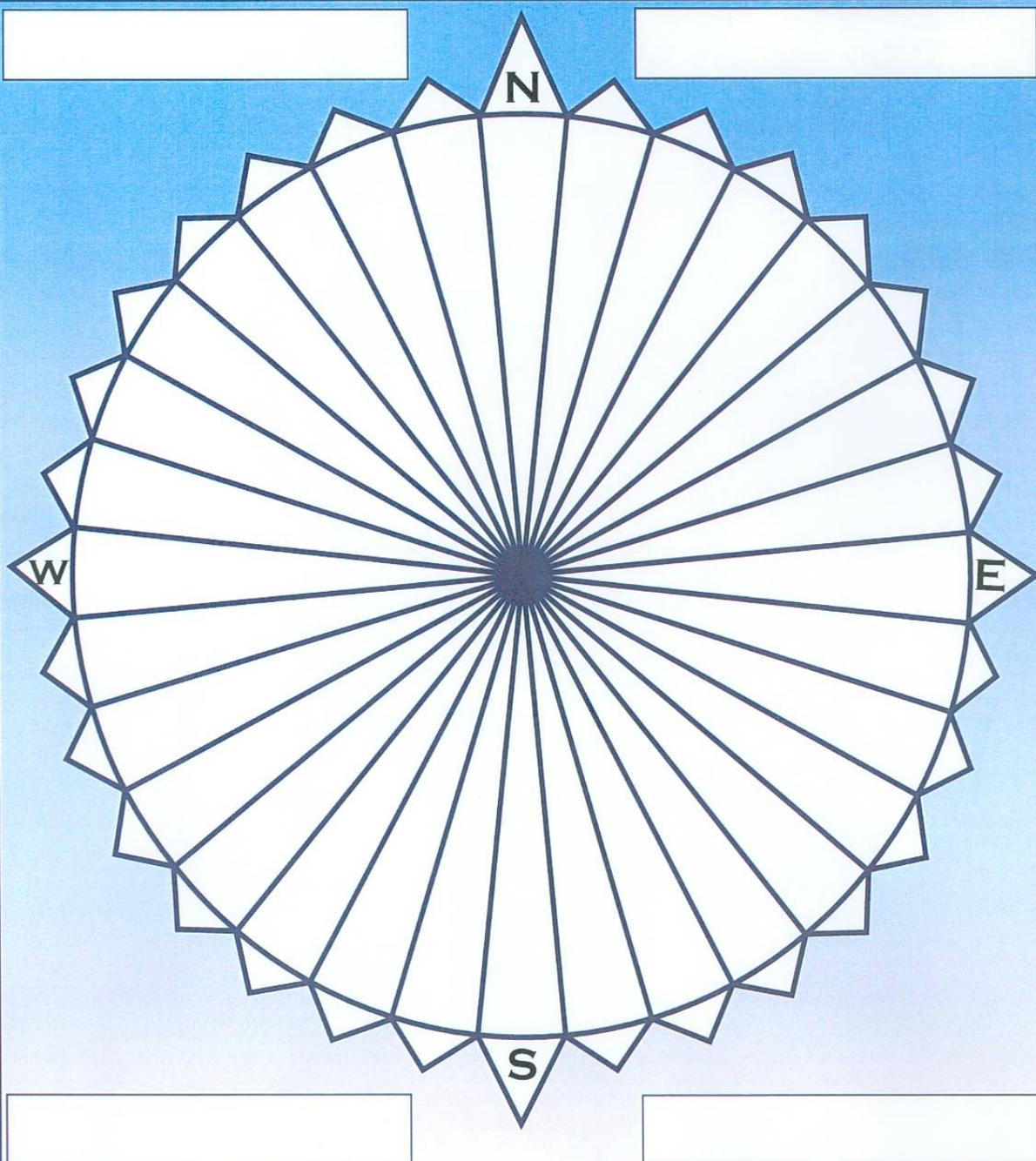
© 2007 by Kamehameha Schools

Worksheets may be used and reproduced for educational purposes



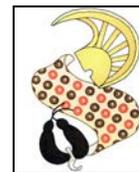
'Ike Pono Hawai'i

Hawaiian Star Compass Houses and Quadrants



© 2007 by Kamehameha Schools

Worksheets may be used and reproduced for educational purposes



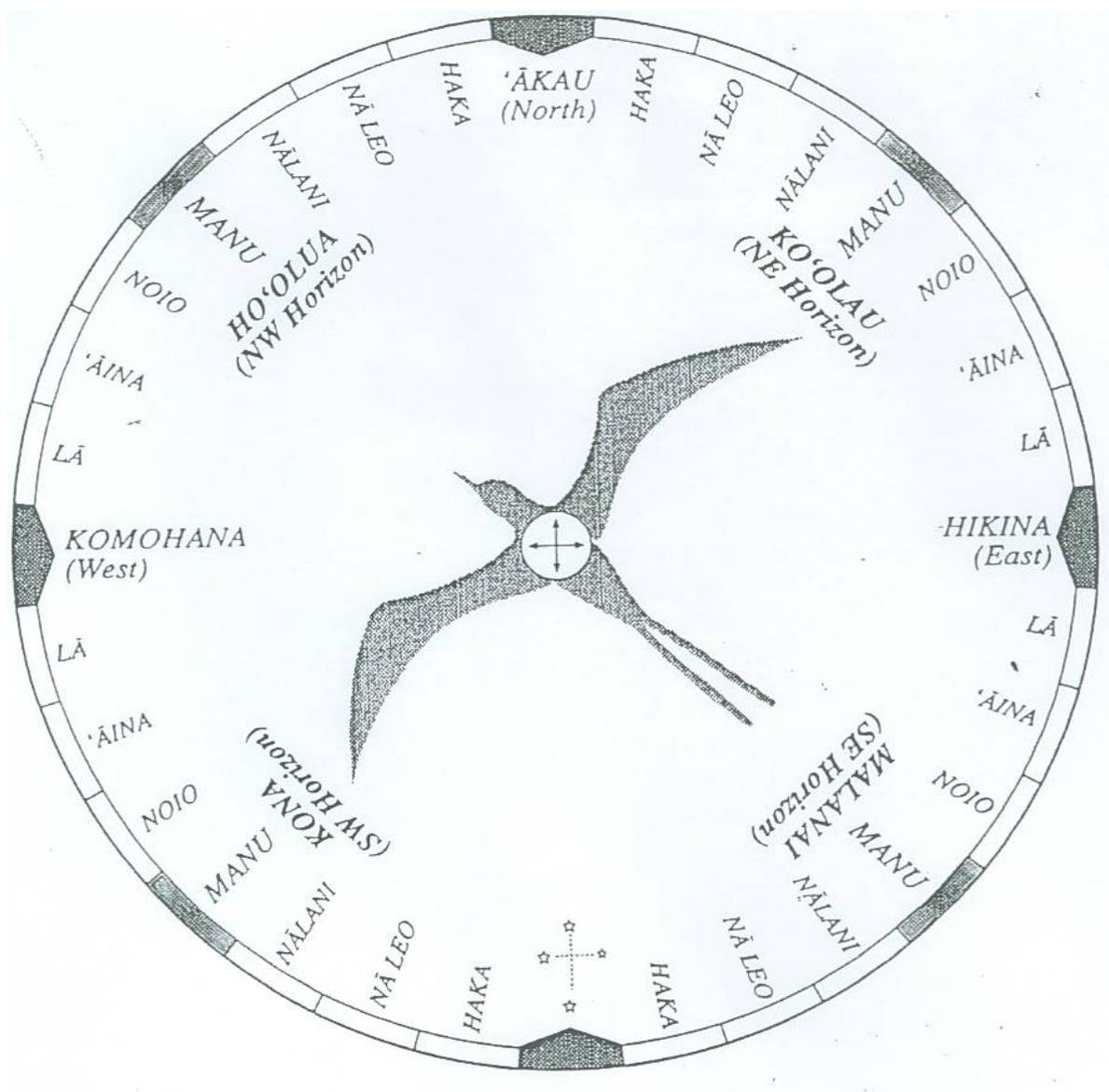
'Ike Pono Hawai'i

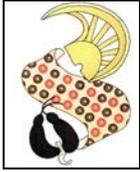
Star House Mo'olelo (Story): Write in the English words.

_____ (Haka) _____ (Nā Leo) _____ (Nālani).

_____ (Manu) _____ (Noio) _____

_____ ('Āina). _____ (Lā) _____.





'Ike Pono Hawai'i

