Activity #1

Navigating the Currents

● ● ● In Advance *Student Reading*

Assign the Student Page "Navigating the Currents" (pp. 15-19) as homework. (Students should bring this reading to class with them.)

● ● ● Class Period One *Charting a Course*

Materials & Setup

- "Map of Pacific Ocean Currents" acetate (master, p. 12)
- "Reference Course and Course Heading Map" acetate (master, p. 13)
- "Map of Currents Between Hawai'i and Nuku Hiva" acetate (master, p. 14)
- Overhead projector and screen

For each group of three to six students

- Student Page "From Nuku Hiva to Hawai'i: Charting a Course" (pp. 20-27)

For each student

- Student Page "Navigating the Currents" (pp. 15-19)

Instructions

1) Show the "Map of Pacific Ocean Currents" acetate to put Hawai'i and Nuku Hiva (in the Marquesas Islands) in context. Ask students if they know which main South Pacific island group the islands of Hiva belong to. (They are in the Marquesas, a part of the "French Polynesia" group of islands.)

2) Divide the class into groups of three to six students. Explain that each group is a team in a voyaging canoe race from Nuku Hiva to Hawai'i. There are just a few more details to complete in planning their journey before they can set sail.

3) Give each group a copy of the Student Page "From Nuku Hiva to Hawai'i: Charting a Course." Groups should work cooperatively to complete the assignment quickly and accurately. The rest of the crew of *Hōkūle'a* is waiting for them—the wayfinders—to complete their work.

4) Allow groups about 20 minutes to complete the student page. If no groups are finished at the end of 20 minutes, you may allow more time. If a few groups finish before 20 minutes are up, quickly check their work to see if there are any obvious flaws they need to correct.

5) When all groups have finished, review the assignment asking groups for their responses to each of the tasks on the student page. Use the teacher version of the Student Page "From Nuku Hiva to Hawai'i: Charting a Course" (pp. 9-11) and the "Reference Course and Course Heading Map"

acetate (which charts the correct course headings). As additional background, you may use the "Map of Currents Between Hawai'i and Nuku Hiva" and the notes in the Teacher Background "Wind and Current Zones in the Pacific" (pp. 7-8).

Journal Ideas

- If you were an ancient Polynesian setting off to settle a distant island, what would you take with you for the trip? What would you take with you to survive in your new home?
- After a month or more at sea, what do you think it feels like for voyagers to sight land?
- What do you think you would feel if you were a voyager stepping ashore? Write a chant or poem that reflects those feelings.
- How do you think Polynesian navigation compares to the way in which fish, corals, and other marine animals originally reached the Hawaiian Islands? Explain your reasoning.

Assessment Tools

- Student Page "From Nuku Hiva to Hawai'i: Charting a Course" (teacher version, pp. 9-11; correct course headings charted on "Reference Course and Course Heading Map" acetate, master, p. 14)
- Participation in group work and class discussions
- Journal entries

Teacher Background

Wind and Current Zones in the Pacific

Based on "Winds, Weather, and Currents of the Pacific" from the Polynesian Voyaging Society website at <leahi.kcc.hawaii.edu/org/pvs>, June 2000. Quotations are from William G. Van Dorn, Oceanography and Seamanship*, 2nd ed., Cornell Maritime Press, Centerville, Maryland, 1993.*

Voyagers among the islands of Polynesia travel through several different zones marked by distinct wind and current patterns. This summary will help you understand these zones and explain them to students.

Northeast Trade Wind Belt (25° N to 9° N)

Winds

- Northeast trade winds, generally from the east, north east (ENE or *'Aina Ko'olau*)
- Ten to twenty knots
- Produced by air circulating clockwise around an area of high pressure centered northeast of Hawai'i
- Summer: trade winds prevail about 90 percent of the time
- Winter: trade winds blow 40-60 percent of the time and are more easterly and generally lighter. Episodes of strong, gusty trade winds are a bit more frequent than during the summer months. Occasional Kona storms bring southerly winds and rain. Winter and spring cold fronts from storms in the North Pacific bring southwesterly winds and rain, followed by cool, dry northerly winds.
- Squalls in the trade wind flow may carry brief bursts of wind up to 40 knots.

Currents

- North equatorial current driven by northeast trade winds
- West-flowing at about .5 knots (12 nautical miles per day)

Intertropical Convergence Zone—ITCZ (varies between 10° N to 0°)

The ITCZ shifts around but, on average lies between 9° N and 3° N between Hawai'i and South Pacific island groups such as the Marquesas and Tahiti Nui.

Winds

- Variable, generally out of the east (*Hikina*)
- Zero to ten knots
- Conditions caused by converging winds from the northeast and southeast trade wind belts and warm air rising from equatorial waters
- Doldrum conditions: variable winds, calms, thunderstorm activity, and dense cloud cover
- The zone is characterized by an "impressive wall of clouds," and a "confused state of the swell, flukey winds that blow intensely and then subside, and intermittent showers of rain that come from nowhere in a solid, opaque overcast" (Van Dorn).

- The light, shifting winds and the confused swells and cloud cover make sailing slow and navigation difficult.
- Sometimes, however, cloudless skies and easterly winds prevail across the zone.

Currents

- Equatorial countercurrent
- East-flowing, but unpredictable
- Sporadic and shifting
- Generally weakest in May/June and strongest in September through November, when its speed can reach about one knot
- Occasionally becomes stronger (This happened in 1992, for example, when the El Niño weather condition brought westerly winds and dangerous winds to the southern Pacific.)

Southeast Trade Wind Belt (0° to 25° S)

Winds

- Southeast trade winds, generally from the east (*Hikina*), east by south (E by S or *La Malanai*), or east by south east (ESE or *'Aina Malanai*)
- Ten to twenty knots
- "Generally stronger, steadier, and cover a much wider zone of latitudes" (Van Dorn) than the northeast trade winds
- Produced by air circulating counterclockwise around an area of high pressure centered around 30° S and stretching westward off the coast of South America
- During the southern hemisphere summer and fall (December-April), infrequent hurricanes form around Tahiti.

Currents

- South equatorial current, driven by southeast trade winds
- West-flowing at .5 knots

For More Information

- On the global air circulation patterns that cause the trade winds and westerlies, see Alpine/Aeolian Unit 2 "Summer Every Day and Winter Every Night," for background.
- On ocean currents and what causes them see Pierre Flament, et al., "The Ocean," *Atlas of Hawai'i*, 3rd ed., University of Hawai'i Press, 1998, pp. 82-86.

Teacher Version

From Nuku Hiva to Hawai‘i: Charting a Course

Task #1: Check the Weather

Safest month or months for *Hōkūle‘a* to sail:

April or May (or both)

Rationale:

To avoid the likelihood of either winter storms or hurricanes in either hemisphere

Task #2: Confirm Your Target Screen

Sighting distances and calculations:

Mauna Kea Square root 9 + square root 13,796 = Distance
3 + 117.5 = Distance
120.5 nautical miles

Haleakalā Square root 9 + square root 10,023 = Distance
3 + 100.1 = Distance
103.1 nautical miles

Kawaikini Square root 9 + square root 5,243 = Distance
3 + 72.4 = Distance
75.4 nautical miles

[Using the formula: Square root of h + square root of H = distance in nautical miles from which an object can be seen (h = height of the observer above sea level in feet, H = height of the object in feet)]

Given the average range of seabirds such as the *noio* and *manu o Kū*, would you be likely to see these landmarks first, or would seabirds likely give away the presence of islands nearby first?

You’d probably see the islands first, since the average range of these seabirds is 60 miles from the island. (Information provided in the Student Page “Navigating the Currents.”)

Task #3: Finalize Your Sailing Plan

Segment 1: In the Southeast Tradewinds

Latitudes: ____9°S_____ to _____3° N_____

Average canoe speed: 15 knots average wind speed x 1/3 wind speed = 5 knots

Average distance traveled per day: 5 knots x 24 hours = 120 miles/day

Total distance to be traveled: 710.6 miles

Total number of days for this segment: 5.9 days

Expected total distance and direction of drift due to the current: .5 knots W x 24 hours = 12 miles west per day x 5.9 days = 70.8 miles west

Heading: NNW

Determine the actual heading with current factored in and draw it on the reference course map. See "Reference Course and Course Heading Map" (p. 13) acetate for answer.

Segment 2: In the Intertropical Convergence Zone

Latitudes: ____3°N_____ to ____9°N_____

Average canoe speed: 7.5 knots average wind speed x 1/3 wind speed = 2.5 knots

Average distance traveled per day: 2.5 knots x 24 hours = 60 miles/day

Total distance to be traveled: 368.1 miles

Total number of days for this segment: 6.1 days

Expected total distance and direction of drift due to the current: Not factored in because it's so variable

Heading: NNW

Determine the actual heading with current factored in and draw it on the reference course map. See "Reference Course and Course Heading Map" (p. 13) acetate for answer.

Segment 3: In the Northeast Tradewinds

Latitudes: ____9°N_____ to ___20° 30' N____

Average canoe speed: 15 knots average wind speed x 1/3 wind speed = 5 knots

Average distance traveled per day: 5 knots x 24 hours = 120 miles/day

Total distance to be traveled: 785.3 miles

Total number of days for this segment: 6.5 days

Expected total distance and direction of drift due to the current: .5 knots W x 24 hours = 12 miles west per day x 6.5 days = 78 miles west

Heading: Between N by W and NNW

Determine the actual heading with current factored in and draw it on the reference course map. See "Reference Course and Course Heading Map" (p. 13) acetate for answer.

Segment 4: Westward to Hāna

Latitudes: ____20° 30' N____ to _____20° 45'N____

Average canoe speed based on wind speed: 15 knots average wind speed x 1/3 wind speed = 5 knots

Expected HOURLY distance and direction of drift due to the current: .5 knots west

Expected actual performance of the canoe (add speed based on wind and current together): 5.5 knots

Average distance traveled per day: 5.5 knots x 24 hours = 132 miles

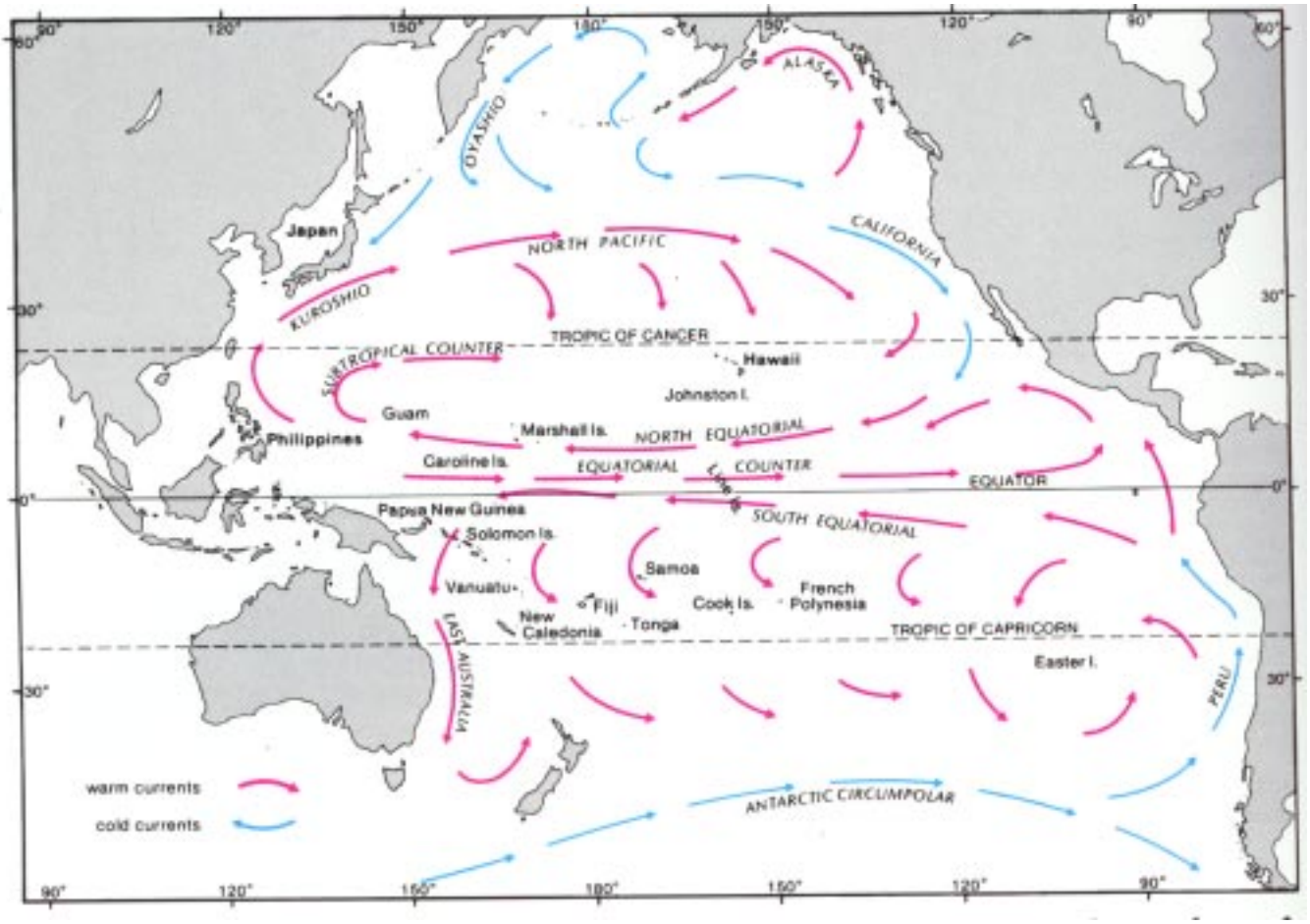
Total distance to be traveled: 405.3 miles

Total number of days for this segment: 3.1 days

Heading: W

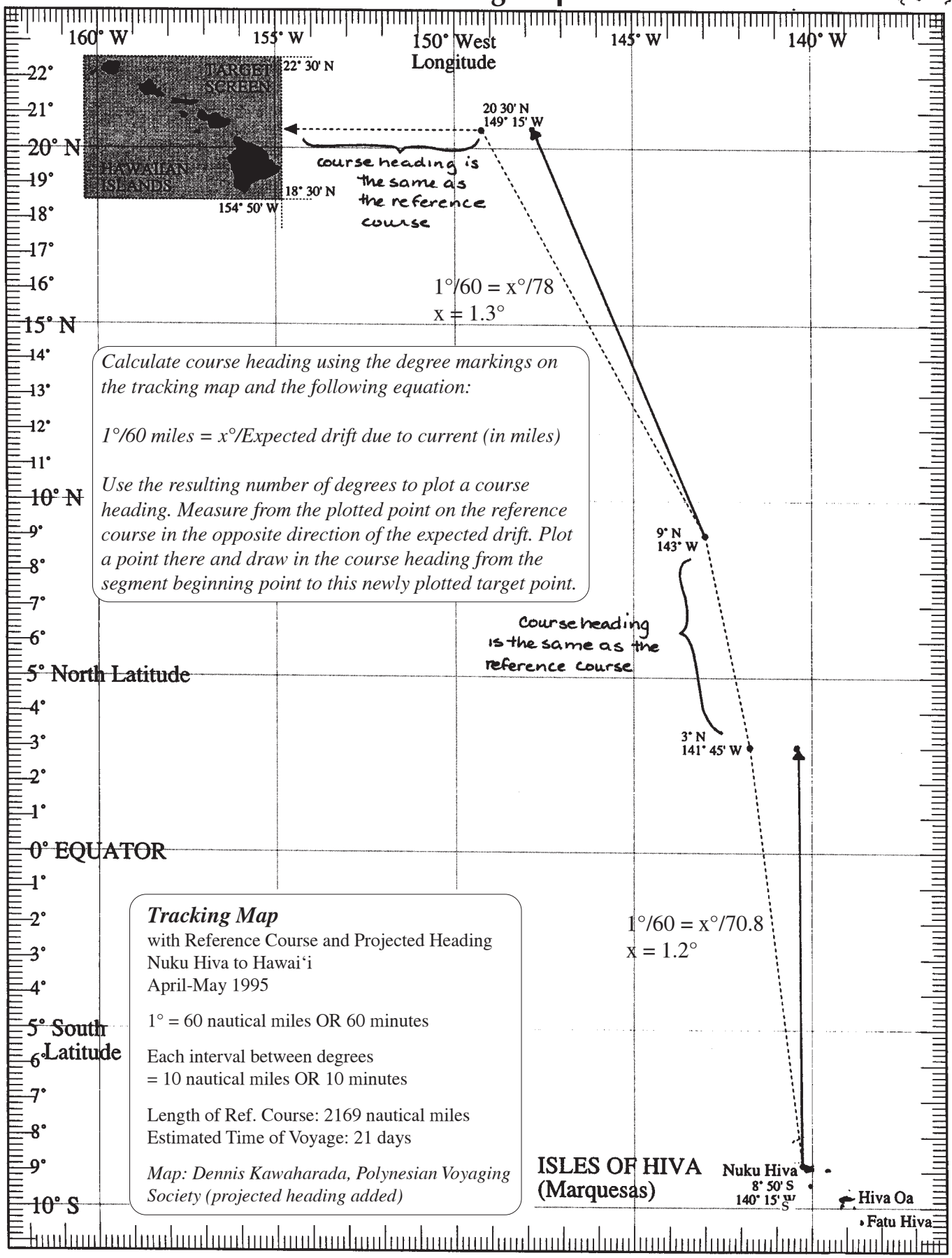
Determine the actual heading with current factored in and draw it on the reference course map. See "Reference Course and Course Heading Map" (p. 13) acetate for answer.

Map of Pacific Ocean Currents



Map: Ann Fielding and Ed Robinson, An Underwater Guide to Hawai'i, *University of Hawai'i Press, Honolulu, 1987.*

Reference Course and Course Heading Map



Map of Currents Between Nuku Hiva and Hawai'i