HO'I ANA IKE KAI

ELEMENTARY-LEVEL TEACHERS' GUIDE

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INTRODUCTION

Maili Elementary School has initiated the development of elementary-level instructional modules in marine education. The University of Hawaii Sea Grant College Program assisted the school and Leeward District Office in formulating the plan to be used in the development of these modules. The Grade 4 Coastal Awareness module uses a strong Hawaiiana perspective, and it is the first module developed under the plan. It consists of three parts: Section A. Life Support which involves food as an ocean resource; Section B. Seamanship which involves ancient and modern Hawaiian navigation; and Section C, the culminating activity, Boat Day.

Teachers who try out this Coastal Awareness module are encouraged to write suggestions and evaluative comments in this publication which we will use as feedback for the purpose of refining and improving this draft module at the end of the current school year, 1979-80.

OPERATIONAL DEFINITION

"An environment is a place. It is a region, setting or context, real or imagined. It may be internal to an object or organism or external to it. It may be microscopic, macroscopic. It may be immediate surroundings or rest outside the reach of human beings."*

STRUCTURE OF THE ENVIRONMENTAL EDUCATION CURRICULUM*

GOAL

The goal of environmental education is to develop an environmentally literate and enlightened society which, through its ethical commitment to wise use of its resources, creates and maintains optimum quality in both human-made and natural environments.

OBJECTIVES

To achieve the goal of environmental education in Hawaii, it will be necessary to attain certain objectives during the period of formal education. No list can be assumed complete, for the dynamics of the environment suggest a need for constant re-evaluation and refurbishment. For this beginning stage, however, the following environmental education objectives can be stated and made to serve as focal points for the various school levels.

Objective 1. Students should develop awareness of themselves in relation to their environment and the need for wise use of the environment.

**A Framework for Environmental Education in the Public Schools of Hawaii*, Department of Education, State of Hawaii, September, 1977.

Objective 2. Students should develop knowledge of the various aspects of the environment--land, water, sea, air, other ecosystems--and the relatedness of human beings, environmental concerns, and the social, political, cultural, and economic structures.

Objective 3. Students should develop skills in coping with environmental problems.

Objective 4. Students should develop attitudes which will help them to live in harmony with the environment.

A diagrammatic explanation of the four objectives is given in Figure 1.

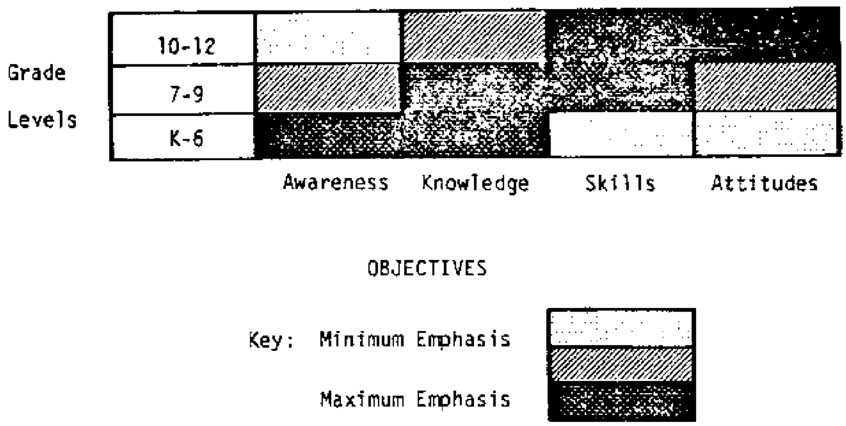

FIGURE 1. SCOPE AND SEQUENCE MODEL FOR ENVIRONMENTAL MODEL*

PERFORMANCE EXPECTATIONS, GRADE 6*

Of the several clusters of performance expectations identified for environmental education, the following are especially pertinent to the Coastal Awareness module.

- Identifies a variety of resources that may be used to gain information on environmental matters.
- Uses a variety of resources to gain information on environmental matters.
- Conducts simple investigations to gain first-hand information on environmental matters.
- Identifies instruments or methods that can be used to gain information about environments or to change an environment for a desired result.

- Identifies recreational opportunities in both human-made and natural environments.
- Describes the environmental factors which must be considered to conduct various recreational activities.
- Explains the effects of environmental changes on recreational opportunities.
- Explains the potential effects of changes in recreational activity on the environment.

- Discusses the effectiveness of school or home rules designed to protect the environment.
- Explains the need for rules to protect the environment.

- Communicates feelings evoked by various types of environments.
- Describes the need for beauty in one's environment.

- Lists a number of environmental factors which may affect the physical or emotional health of human beings.
- Discusses attitudes which contribute toward living in harmony with the environment.
- Identifies and describes environmental factors which influence the beliefs of different cultures.
- Identifies specific contributions one can make to help human beings live in harmony with the environment.

- Identifies non-government groups primarily concerned with environmental matters.

ACKNOWLEDGMENTS

The Coastal Awareness module was developed during the summer of 1979 by three teachers who were contracted by Leeward District Office under the auspices of the Department of Education's Environmental Education Program. Credit for developing the modules go to:

Colleen Murakami	Maili Elementary School Section A
John Burke	Waianae Elementary School Section B
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Curriculum Research and Development Group, University of Hawaii

University of Hawaii Sea Grant College Program

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SECTION A

LIFE SUPPORT

Life Support

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Topic: Plants (Draft)

OBJECTIVES: The students will:

1. Create a legend to explain how a plant came to Hawaii.
2. Predict the weight of different parts of the coconut.
3. Learn how to properly use a simple balance.
4. Record their measurements in tabular form.
5. Demonstrate at least one of the uses of the coconut.
6. Make a plate out of coconut leaves.
7. Make a bowl out of coconut shell.
8. Design and test a method of preserving poi.
9. Identify at least three (3) edible seaweed.
10. Construct an "art form" out of found materials from the beach.

MATERIALS NEEDED:

Coconut for class
Coconut leaves for weaving
Taro Root
Samples of seaweed

ADVANCE PREPARATION:

FIELD TRIP TO PUULOA BEACH PARK - You will go to this beach site mainly to pick seaweed. Have students bring either old pillow case to carry the seaweed or use ziploc bags. Also, bring buckets and pans so the students can clean their seaweed at the beach.

COCONUTS AND COCONUT LEAVES - Each student needs half a shell to make a bowl. Lots of leaves should be collected. Don't bring to school too early; the leaves will dry and its hard to work with dry leaves. You will need a knife to cut the leaves from the main stalk.

PROCEDURE:

1. Make a list of the plants that the students think the Hawaiian used for food. For example; sugar cane, sweet potato, mountain apple, bread fruit, taro, banana, popolo, aweoweo, coconut, etc.

   From this list, have the students circle the plants they would like to take on their imaginary sea voyage.

   Have the students pick a plant they like and have them write a legend on how that plant came to Hawaii. Or they can write about how that plant was discovered, how it obtained its shape, color, texture, or other peculiar characteristics. For example, one student could write on how the coconut got it's "eyes".

   Read some of the legends to the class, others could be read at their own leisure at a "sharing corner" in the classroom. Send some students to other classes to share their stories. Also, a puppet show could be made from their legends...have a whole production to share at a PTA meeting or to videotape to share with another school.

2. Have students bring coconuts in. (The coconut should be "ripe " and about the same size). Do a weighing activity.
   "How much does the whole coconut weigh?"
   "What other parts can you weigh?"
   "Which part of the coconut do you think is the heaviest?"
   Which part of the coconut do you think is the lightest?"

   Before the students crack open the coconut, be sure to tell them to keep all the parts of the coconut for future use. The coconut shell needs to be cracked in half for use as bowls.

   Have the students collect their information in tabular form.

COCONUT PARTS	PREDICTED WEIGHT	ACTUAL WEIGHT
whole coconut		
husk		
water		
shell		
meat		

Looking at their data and the data of their friends, students should decide which part of the coconut is the heaviest? the lightest? Were their predictions right? If not, have them explain. What caused the difference in weight between coconuts? Predict the heaviest and lightest part of an old brown coconut---is it the same as your ripe coconut? Why or why not?

3. Discuss the importance of the coconut to the ancient Hawaiians. The leaves were used for clothing, trays, ornaments, shelter, etc. The husk was used for rope, brush, strainer, etc. The shell was used as bowls, fishhooks, utensils, etc. The meat was used for food and oil. The water used for drinking.

   Have the students ask their parents about the many ways they use the parts of the coconut tree.

   Make a list of all the ways the coconut tree can be used. Have the students divide into groups and pick one or two uses of the coconut tree to demonstrate to the class.

4. Have the students decorate their coconut shells (these were saved in procedure #2). Be sure they only decorate the outside. The inside should remain clean because they might want to use these "bowls" for drinking water. Store these "bowls" away for Boatday.

5. Have the students weave with the coconut leaves. They need to weave a plate for their "boatday" meals. It would be to the students' benefit if they think of making some kind of head and eye protection from the sun. (Maybe a sun visor out of coconut leaves or other materials.) The students are just practicing to weave at this stage. The food trays and sun visors that the students use will be made during their imaginary sea voyage. (See background information for instruction to make a tray...if you can get parents to come in to help teach the students to weave, this is a good opportunity for you to get to know your students' parents.)

6. Have students make poi out of taro. What do you need? A wooden tray and poi pounder...get them from students' parents or borrow them from the Polynesian Voyaging Society.

   Using the poi they made, or buy from the market, have the students design an experiment to preserve the poi. Then try it...

   "Can it be freezed dried?"
   "Can poi be dried in the sun?"
   "Can it be reconstituted with water?"
   "Can you make taro chips or poi chips?"
   "How do you know if your experiment was successful? Would you eat what you made?"
   "Would this make a good economy? Call or write to potato chip factory...Ask them about making poi chips. Find out how they make their chips. Send them a sample of your chips. Compare your chips to their chips...is it the same?

7. Which seaweed is edible? Discuss the definition of edibility. Show that certain food that is favored by some people is detested by others and vice versa.

   (get samples of seaweed and have the students identify the seaweed. Or, use drawings from a book as an alternate.)

8. Go on a field trip to Puuloa Beach Park. Collect seaweek for eating and for art activities. Try drying some seaweed. Is it practical? How does dried seaweed taste? Would you eat seaweed that is dried and reconstitute with water? How would you prepare some seaweed to be eaten on "Boatday"?

   During the field trip, students should look at the land plants growing along the coastline. Do they have possibility of being eaten? Can they be used as decoration or made into a lei? Try making a lei without using a needle.

9. Go over the list of plants the students would take on their imaginary sea voyage. Have students make revisions. Add other plants, delete plants they don't want. Have them give reasons for making the changes. Save this list until the unit on preserving plants is finished.

SUPPLEMENTARY ACTIVITIES:

1. Students can find out how other plants were used---ti plant, mangrove, lauhala, banana, etc.

2. Students can try making plates, trays, bowls, utensils, etc. out of other natural materials of their choice---ti leaf, lauhala, shells, banana leaf, etc.

3. Predict which is heavier - a green coconut or a ripe coconut. Which part is the heaviest? The lightest? What makes the coconut heavy or light?

4. Pick a plant and find several uses for all the parts of the plant. Try to recycle every part of that plant. Make a booklet or role play the plant.

5. Do some cooking with the seaweed or coastal plants. Make haupia, ogo, soup, have a party! Try making limu chips. Make clam dips.

6. Do limu pressing. When the seaweed is dried and pressed---Make greeting cards
   - Book marks
   - Playing cards to remember the type and which limu is edible
     (make 4 of each so they can play different card games.)

7. Do a nutritional study of the plants. How did the Hawaiians know they were eating a balanced meal? How do we insure ourselves of a balance diet today?

RESOURCES:

Sasaki, June, Polynesian Crafts Step by Step, Petroglyph Press, Hilo, HI., 1978.

Goodloe, William, Coconut Palm Frond Weaving, Charles E. Tuttle Co., Vermont, 1976.

Aloha Council, BSA, Hawaiiana, A Handbook for Scouts, Honolulu, HI., 1973

E.S. Craighill Handy, Kenneth Emory, Edwin Bryan, Peter Buck, John Wise, etc., Ancient Hawaiian Civilization, Charles E. Tuttle, Co., Inc., Vermont, 1965.

Polynesian Voyaging Society. phone 841-3966

Field Keys to Common Hawaiian Marine Animals and Plants, Office of Instructional Services, General Education Branch, Department of Education, State of Hawaii, 1978.

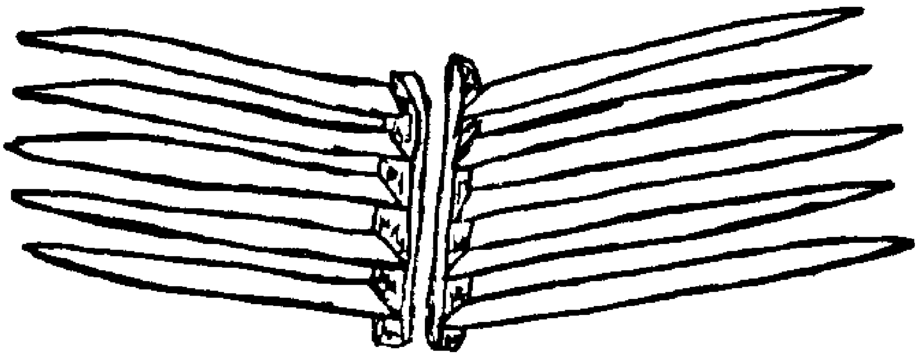
Fielding, Ann and Mariz, Barbara, Coral: A Hawaiian Resource (draft) Waikiki Aquarium

FOOD TRAY

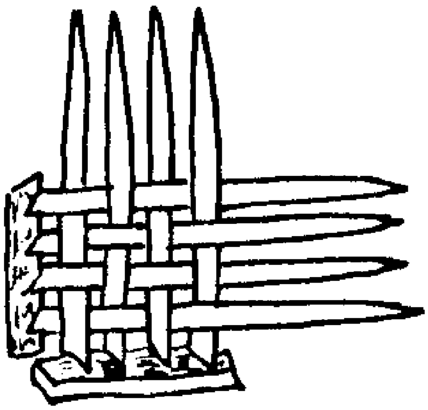
1. Select a leaf with long leaflets, not wind-whipped, and one with leaflet neither very close together nor very far apart. A leaf from a tree old enough to have produced coconuts will be the better. (The entire plant is the leaf, or frond, and the individual sections are leaflets.)

2. When splitting a coconut leaf in half, lengthways, always split from the tip toward the butt. Cut in the same direction to the midrib.

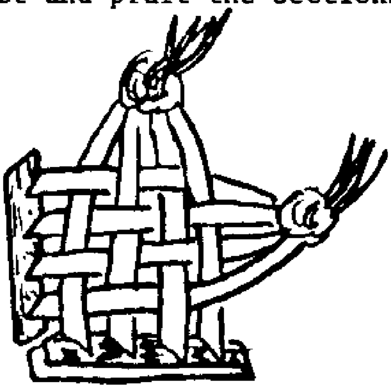
3. For the food tray, select leaflets closer to the butt end. Use about five leaflets for each side.



1) Use long, narrow leaflets from the butt end.



2) Spread each leaflet and plait the sections as shown above.



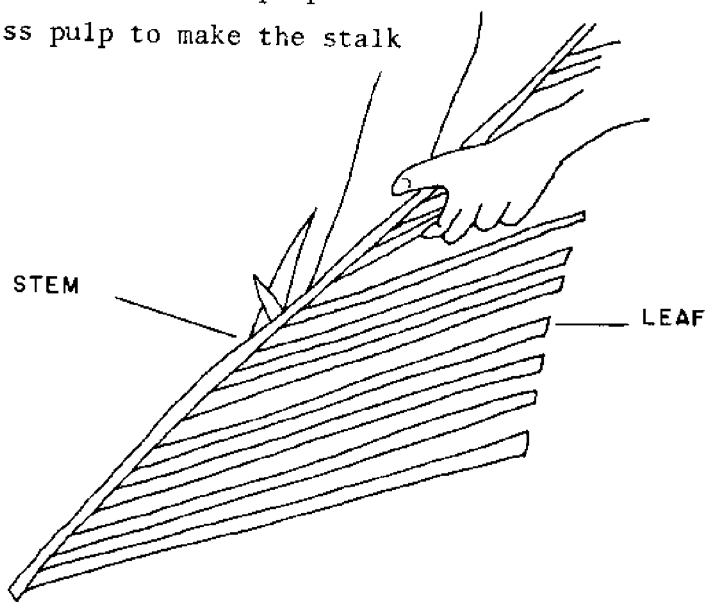
3) The ends of the leaflets on each side are then tied into an over-hand to complete the food tray.

COCONUT HAT

PREPARE FROND

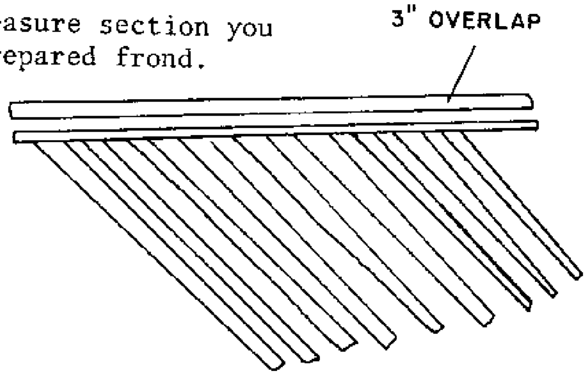
1. Select young frond that has long leaves.
2. Split stalk of frond in half with a sharp knife.

   Use right half of frond for right handed people and left half for left-handed people.
3. Shave off excess pulp to make the stalk flexible.



4. Measure your head size by winding a leaf around your head with a three-inch overlap.

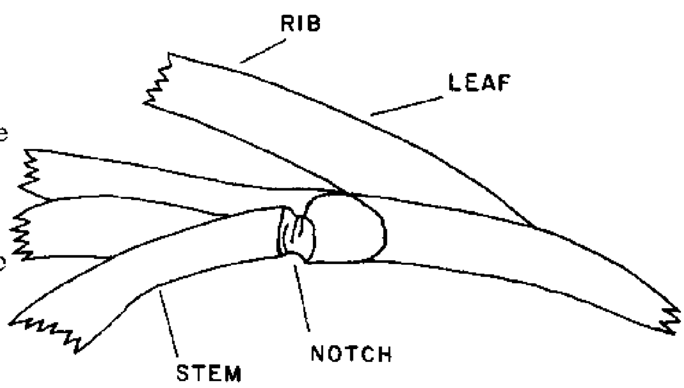
   Use this strip to measure section you need and cut from prepared frond.



5. Bend the stem in a circle to head size and overlap ends of prepared frond.

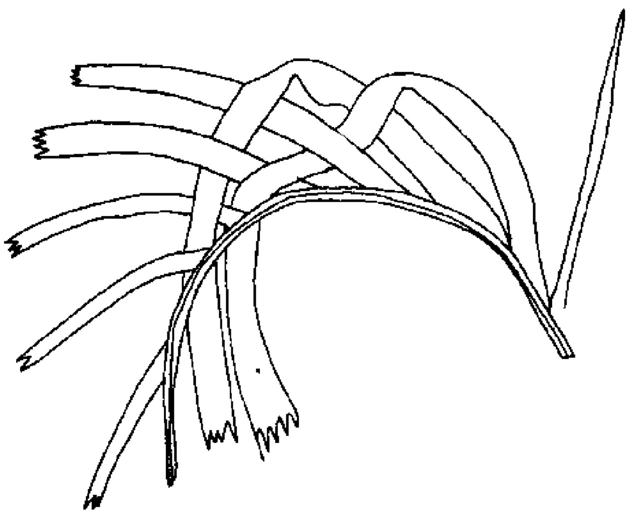
   Notch both ends at the top and the bottom.

   Wind several times with twine and tie tightly together with a square knot.



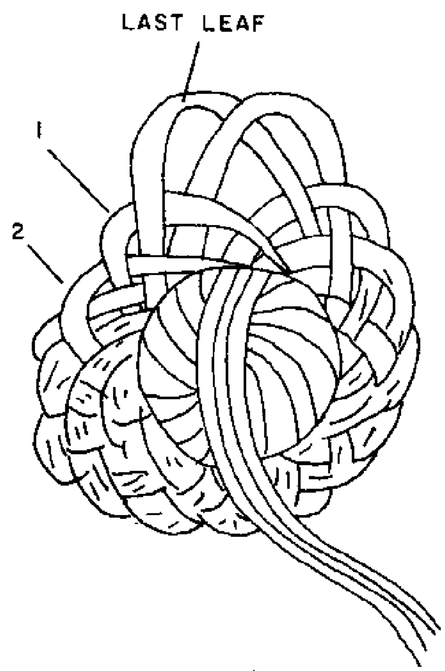
WEAVE BRIM

1. Face midribs down. Weave in the direction of the leaves.
2. RULE: Always weave OVER, UNDER, OVER, UNDER.
3. Begin by selecting one leaf on the right side of the circle closest to you, and weaving it over the first leaf, under the second leaf, over the third leaf, and then under the stem and up inside the circle of the stem.
4. Now take the leaf immediately to the right of the woven leaf and weave it in a similar manner.



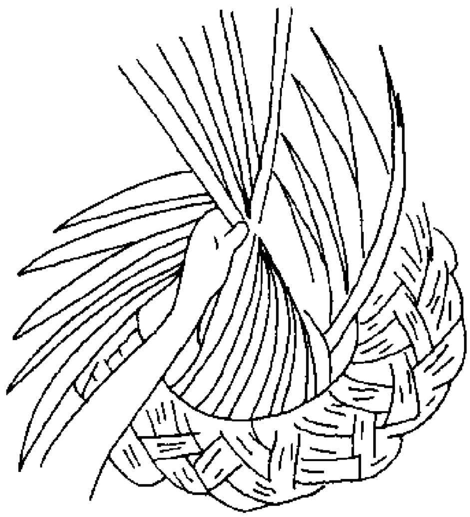
5. Continue around the hat until all the leaves are interwoven.

   The first few leaves should be woven loosely to allow room for weaving the last few leaves in between them.



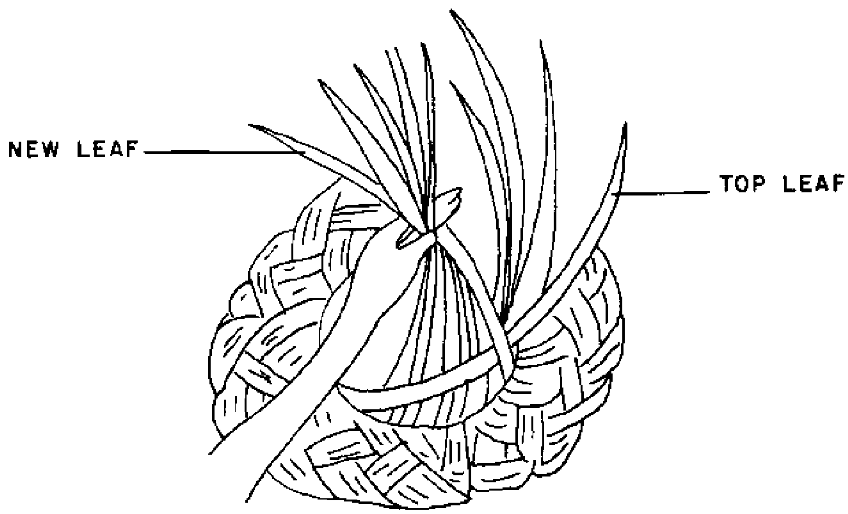
WEAVE CROWN

1. Count the number of leaves in the hat. If the number of leaves is even, divide it by two. If the number is odd, add one before dividing by two.
2. Hold half of leaves. Keep them in sequence with first leaf facing to the left and last leaf facing to the right.
3. Twist and fan leaves so that the first leaf faces to the right side and last leaf faces to the left side, all forming a teepee.



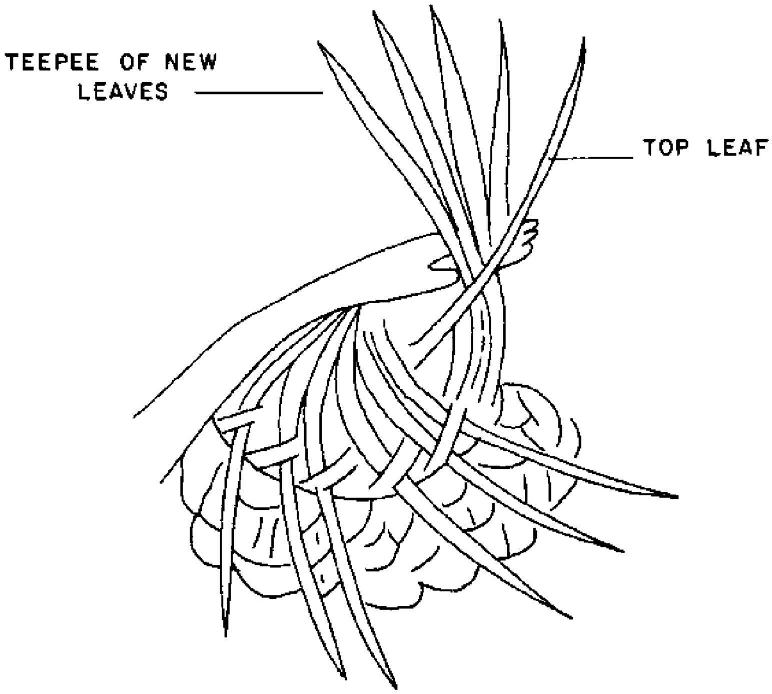
4. Take the top leaf on the right of the pile (teepee) and place it under a new leaf from the leaves left on the bottom.

   Leave this top leaf alone in front of teepee and place the new leaf behind the teepee pile. Keep all succeeding leaves in order each behind the other.

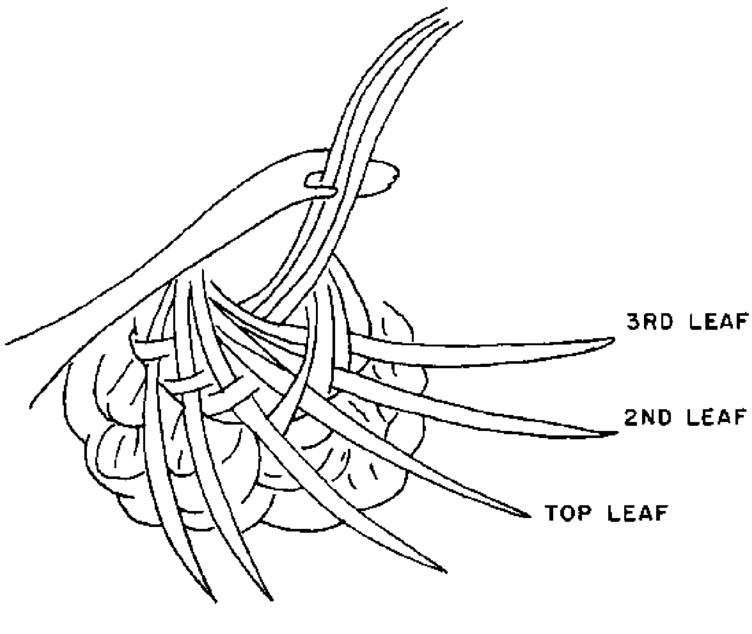


CROWN CONTINUED

5. Repeat this process until all leaves are in and you are left holding the new leaves forming another teepee.



6. Take top leaf of teepee and weave under the first leaf on bottom. Then take next leaf of teepee and weave under the second leaf on bottom. Repeat until all leaves are in.
7. Pull leaves to shape crown.
8. Weave another row by weaving end under the next leaf.



PINWHEEL

1. Remove leaflets from midrib, cut off tapered ends, save midrib for step 8.

2. Fold leaflet A at an angle as in figure 1.

3. Insert leaflet B, shiny side up, into fold of A leaving top half slightly longer. (Fig. 2)

4. Wrap top of B backwards, form a loop in back, come forward, cross over front of leaflets A. (Fig. 3)

5. Take the longer part of A, top part, and weave in a right to left direction, over, then under B leaflets. Pull, tighten, flatten to a square. (Fig. 4)

6. Turn square over so that the cross in back faces you. (Fig. 5)

7. Fold A to the left, fold B down over A, fold C to the right over B, fold D up, over C, under A, Form a square. (Fig. 6)

8. Create the ends of the pinwheel from the loose ends. Suspend from the midrib by inserting the midrib through the center of the weaving.

Fig. 1

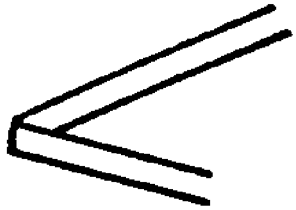


Fig. 2

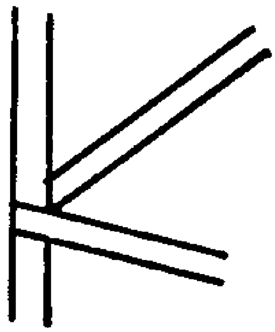


Fig. 3

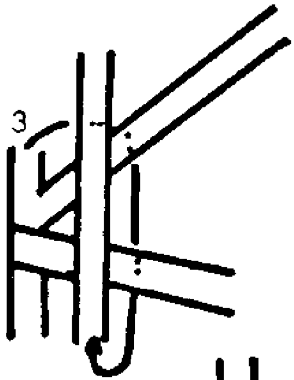


Fig. 4

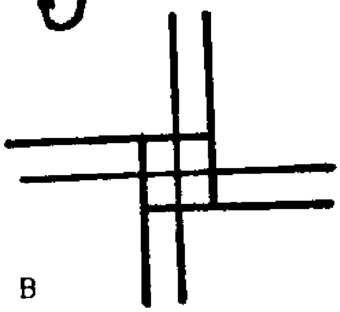


Fig. 5

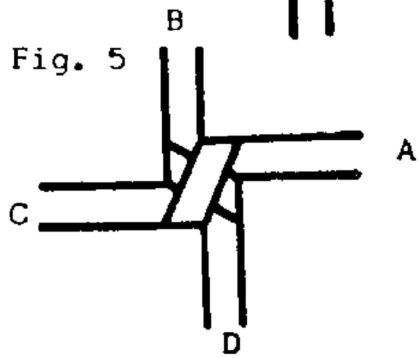
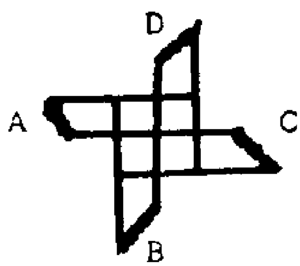
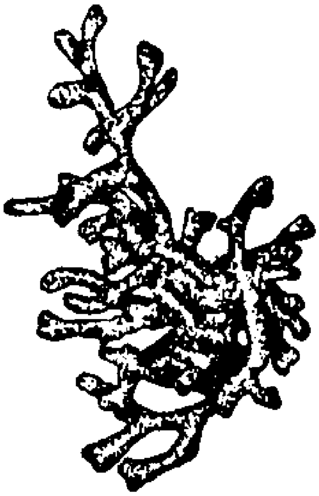


Fig. 6



LIMU



Codium edule

LIMU WAWAE'IOLE - very dark green; forms a mat on the coral; round, branched, tube-like stems.

Gracilaria coronopifolia

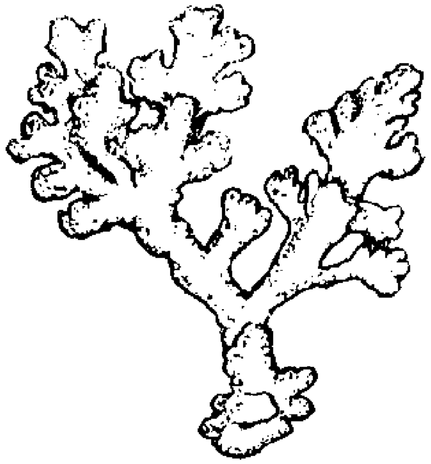
LIMU MANANEA, OGO - dark rose, greenish; cylindrical branches; grows in small bushes.

Abnfeltia concinna

LIMU'AKI'AKI plants 6-12 inches high growing in thick erect golden brown clumps on pahoehoe lava boulders, branching densely near the tops of the plants.

Asparagopsis taxiformis

LIMU KOHU - dark red, brown, tan; holdfast makes strong creeping branches on reef; erect branches (3 to 5 inches tall) have soft



Laurencia

LIMU LIPE'EPE'E dark purple to brownish and dark red with branchlet making small bumps along the margins.

Dictyopteris plagiogramma

LIMU LIPOA, DICTYOTA - wavy, golden-colored blades with prominent brown midrib down the center of the branches; grows in deeper water but is sometimes cast ashore.

Sargassum echinocarpum

LIMU KALA - golden-brown color, stiff blades like holly leaves with spiney teeth; floating bladders attached to stipe; feels stiff and rough. A species with much larger leaves is common in the Atlantic Ocean. It floats in large bunches near Bermuda making what is called the Sargasso Sea.

BACKGROUND INFORMATION ON LIMU

I. Safety

II. The Types of Limu - Lī poa, A'ala'ula, 'Aki Aki, Wā wae'iole, Limu Kala Mana uea, Li'pe'e pe, and Limu Kohy

III. Shells - Ina, Pipipi, Leho li iilii, Hā uke' uke'

IV. How to pick

1. Never eat while picking. (tradition)
2. Respect the sea: watch out for the waves at all times.
3. Pick up, feel, and smell to tell the difference among varieties.
4. Best time to pick is low tide.

TOPIC: FISHING (DRAFT)

OBJECTIVES: The student will:

1. Understand the Hawaiians' dependence on the ocean for food - fish, crab, lobster, shrimp, etc.
2. Select and construct a device for catching a crab or fish.
3. Understand the meaning of conservation.
4. Identify the parts of a fish.
5. Construct a box fish.

MATERIALS NEEDED:

Twine and net needle for making a net
Found material for making a trap
Shells or wood to make hooks
Daphnia and baby bottles
Small box, milk carton to make "box fish"

ADVANCE PREPARATION:

Make plans to go to Maili Beach Park to test crab or fish nets....(A stream or canal will do, too.)

Make plans to visit a fish market.

OPTIONAL: Visit an aquaculture farm

PROCEDURE:

1. Discuss with the students:
"What do you think the ancient Hawaiians ate?"
"Where did they get their food from?"
"How did they obtain their food?"
"Why did they eat what they did?"

2. Either tell your students about the ancient Hawaiian fishing styles or have them do research on them --- Catching by bare hands, spearing, noosing, netting, trapping, hooking, or poisoning.

3. Have the students do any of the following:
   Make fish hooks out of shells or wood.
   Make fish or crab nets out of twine, using net needles.
   Make a fishing or crabbing device of their own design using milk carton, cans, cardboard, screen, foil, nylon stocking, etc.

   Go on a field trip to Maili Beach Park to test out their products, or have them test it out with their family at the beach.

4. Discuss with the students the kapu (tabu) system on fishing. Students can compare the old Hawaiian kapu laws on fishing with our modern fishing laws. How are they the same? Is any system better than the other? Or do they serve the purpose for their time period? How can our fishing laws be improved?

   Call in a fish and game warden to talk to the students about the necessity to have laws and the problems they have in enforcing the laws.

5. Students can design an experiment on conservation of our fish supply. Have them note the problems, advantages, and disadvantages of raising fish, daphnia, snails, or crayfish.

   Students will observe 3 separate baby bottles with the same number of daphnia. (About 10 daphnia)

   Bottle #1 - every two to four days, the students will remove 2-3 daphnia.

   Bottle #2 - every two to four days, (same as above) students will remove 4-6 daphnia. (Amount should be double than that in bottle #1)

   Bottle #3 Students will not remove any daphnia at all.

   After 2-3 weeks, discuss what is happening in the three bottles. Hopefully, most of the daphnia in bottle #3 would have died due to over population. Bottle #2 would have a few daphnia due to depletion of the population by the students. Bottle #1 should have the most daphnia due to wise use of their supply. (This is just an idea which needs to be tested out by the students.)

6. Visit a fish market. Observe the type of fish that is popular to our community today. Find out how price varies according to the supply and demand of the 2 most popular fish.

Bring some "cheap fish" back to class.
Have the students identify the parts of the fish. (Outside as well as inside!) Be sure to remind the students to be careful when they're opening their fish. Let them use single edged razors or X-acto knives.

Save the fish parts and have the students make a menu. Make "pupus" for the students to taste or if you're game, have the students make a "fishy lunch".

7. After the students know the parts of a fish, and tasted it too, have them make "box fish", using a box as the body. Let them "dress" their fish any way they want, using only scrap materials. Have them give their fish a name.

   Using the beautiful and original fish the students made, play some games to sharpen the students' thinking skills.
   1. Put all the fish on one table and the names on another table. Have the students try to match up the fish to their names.

   2. Let students make a list of the qualities and behavior of their fish. Other students have to guess which fish it is.

8. Have a fisherman come in and talk about finding the "good fishing grounds". Can they tell where the fish is running good? How do they read the natural signs that tells them where the fish is? When is the best time to fish according to the tide, season, sunlight, etc.

SUPPLEMENTARY ACTIVITIES:

1. Let students find out if a fish can breathe.

2. Have students taste cooked pipipi. They can find out what other types of shellfish are edible - opihi, urchins, etc. Have students make ornaments with the empty shell of the shellfish.

3. Visit an aquaculture farm. Have them observe how Hawaii is turning to aquaculture for another means of food supply.

BACKGROUND INFORMATION:

The Hawaiians were very good fishermen since they depended on the ocean for their main protein food source, either fish or shellfish. Everyone from the highest chief to slaves and children knew several techniques of obtaining fish.

The Hawaiians caught their fish by spearing, noosing, netting, trapping, hooking, poisoning, or by using their bare hands. The Hawaiians would stick their hands into pukas (holes or crevices in the reef) and under rocks. We should stress to our students not to use this particular technique for their own protection. They might cut themselves or get bitten by an animal. Also, the students should not use "poison" to catch their fish. They might get carried away and use too much toxin and harm the environment.

The Hawaiians also had a strict kapu system on fishing. They could not do shore fishing during certain seasons and deep sea fishing in others. These seasons coincided with the fish spawing season. The kapu system insured the conservation of their fish supply.

Information on identifying the parts of a fish and making a net will come on an attachment.

RESOURCES:

Books:

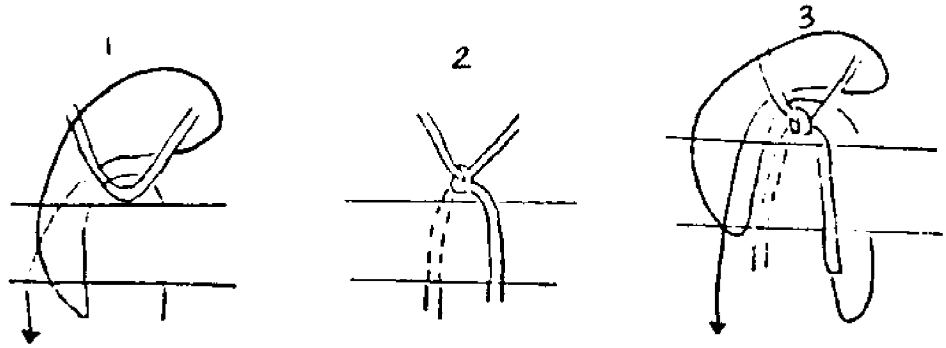
Aloha Council, BSA, Hawaiiana, A Handbook for Scouts, Hon., Hi, 1973.

E.S. Craighill Handy, Kenneth Emory, Edwin Bryan, Peter Buck, John Wise, etc., Ancient Hawaiian Civilization, a Series of lectures delivered at Kam School, Charles E. Tuttle Co., Inc., Rutland, Vermont, 1965.

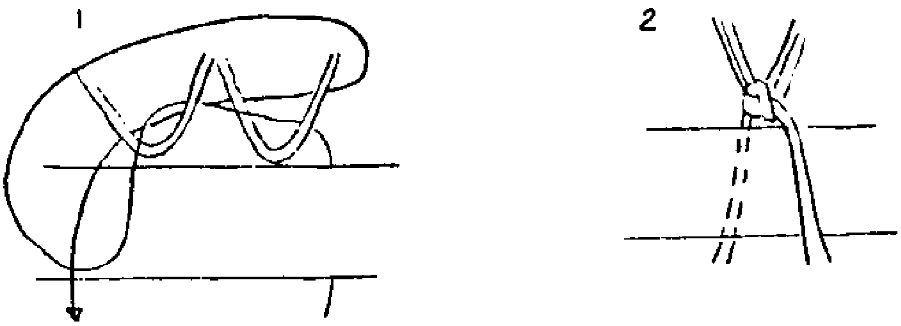
Titcomb, Margaret, Native Use of Fish in Hawaii, University Press of Hawaii, Honolulu, Hi, 1972

FISHING: TYPES OF KNOTS

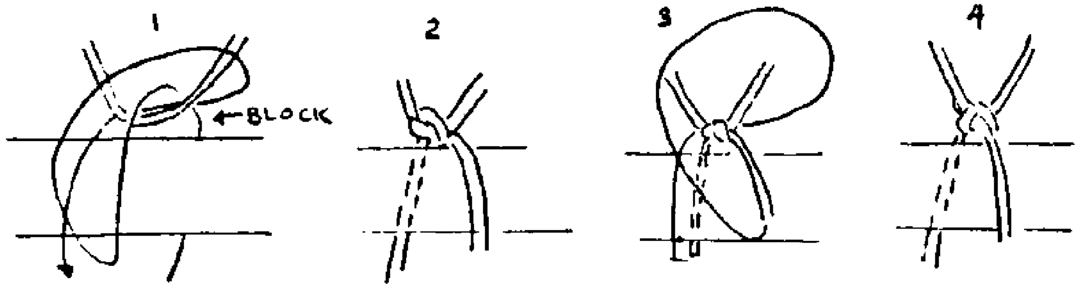
Add Eyes: Take loop; block and make hitch knot; then go in front of measuring device and back; and instead of taking next eye, go between the same that was knotted and block; then hitch knot.



Decrease Eyes: Take 2 eyes at a time and go in back of four and knot.

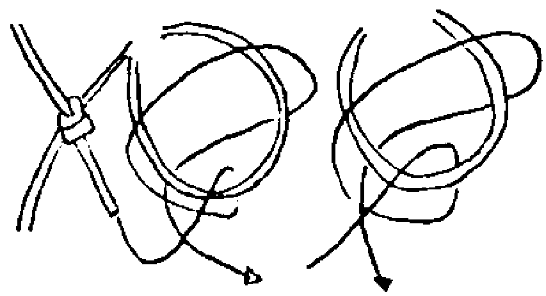


Double Knot: Knot and block and knot again over the same knot.



Completing Top (For bottles; glass ball decorations after the completion of the net)

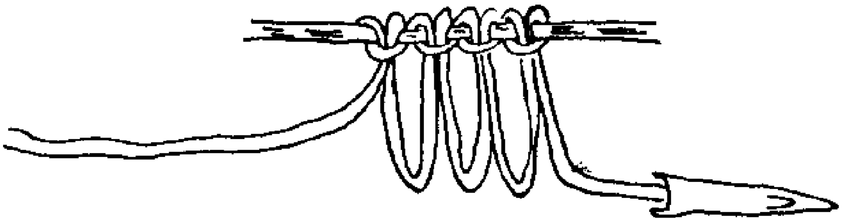
Take loops, go in front and back of loop (knots should be on bottom) Taking turns until all the loops are used; join by either buttonhole stitch or wrap then join both ends of loose strings with square knots.

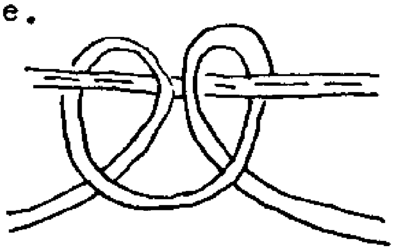


FISHING: NET MAKING

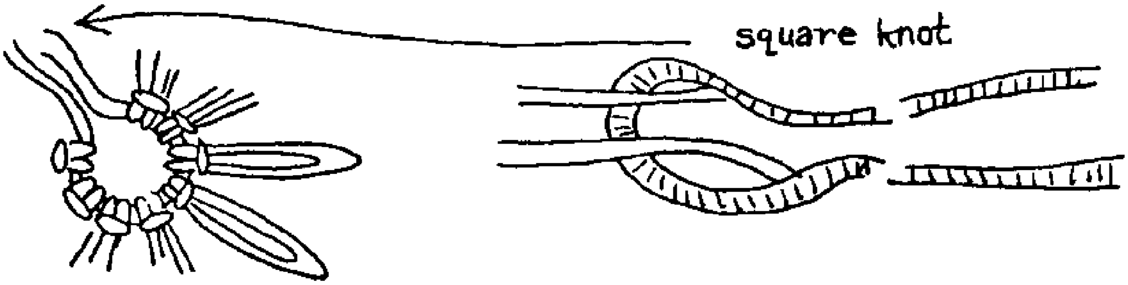
Start off making initial loops by getting a piece of string and tieing ends on to something so string is taut.

To make loops, hold tail about a yard long in left hand and needle in right. Put needle over tight string and under, come out on left side of tail, and in front of tail. Then go under and over string and through loop and pull. Repeat same process to make loop but leave some string hanging for loop depending on size of loop. Repeat same process to make all loops. Be sure all loops are of same size.

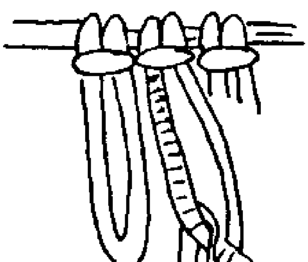


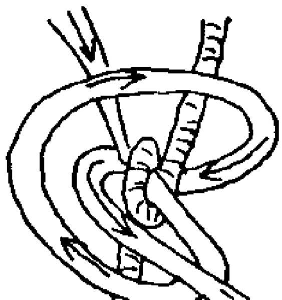


After enough loops are completed, tie ends of string holding loops in square knot (left over right, and right over left). Then cut off excess. DO NOT cut off tail string and needle string.



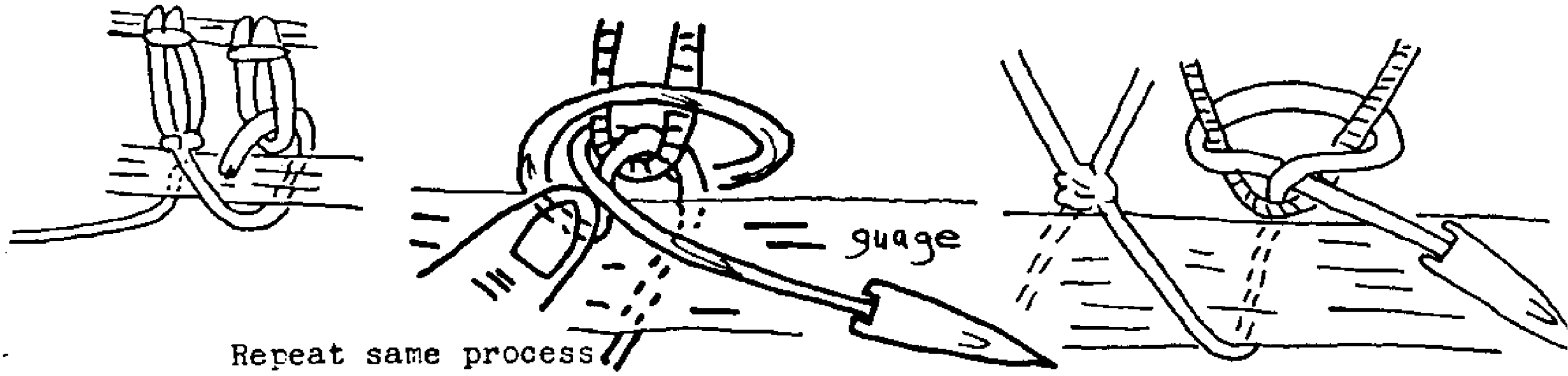
To join tail and needle string together, tail string should be on right side and needle on left. Place needle over tail towards right and under loop so that you hold tail string in left hand and needle string in right. Pull until the loop is even with other loops. When it's even hold tail in left hand at knot tightly and with needle in right hand, make loop with string on needle over the knot so that loop is on left side of knot and tuck needle under loop (2 strings you're joining) and up through loop just made on left side of knot. Pull with right hand - do not let go of knot with left hand until knot covers first knot.





Now you're ready to start next row.

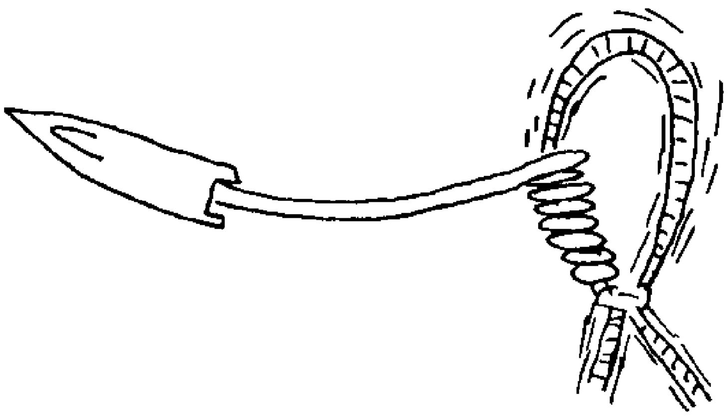
Place measuring device (used to measure size of loop) between tail and needle string (needle should be on top). Bring needle string on top and place needle under and thru first loop and pull towards you until the knot on the side are even and bottom of loop is even with edge of measuring device. Hold top with left thumb and made knot by placing needle string on left forming loop and going under first loop and through second one just made with needle string and pull let string slide off of thumb so that knot will not slip



Repeat same process

Make as many rows as needed - depending on object covering should be 3 rows above object. Do not tie to join rows.

To complete top, grab top loops after object has been placed in net and grab 1st loop and the back of second and so forth so that you are holding all the loops and it forms 1 large loop. With needle, either wrap loops together tightly and closely at base and all around to other side and tie in square knot; or make buttonhole knot placing loop on left-hand side and take needle under all the original loops at base and through other loop just made and pull tight - made sure first knot is at base, go all around and end at other base, then tie in square knot.



TOPIC: SALTMAKING (Draft)

OBJECTIVES: The students will:

1. Calculate which is cheaper - to make their own salt or to buy it from the market?

2. Compare the quality of different types of salt.

3. Prove whether salt will form the same type of crystal when the water evaporates.

4. Examine and draw salt crystals viewed under a microscope.

MATERIALS NEEDED:

sea water, tray to evaporate water

different types of salt, balance, microscope, shallow dish or petri dish

PROCEDURE:

1. Have students taste two (2) same stock soup. Only difference is one has salt, the other doesn't. Discuss which they like better - soup A or soup B? How can you improve the other soup ? Try it. Have the students rinse out their mouths after each taste test so that they can have a better taste of each flavor. (Make a clear broth soup out of fish or bone) OR

   Discuss with the students the importance of salt. Do we really need it? Is it used only for cooking? Why is it used for cooking?

2. Have the students find out if it is cheaper to make their own salt or to buy it from the market. (Get sea water and try to get salt through evaporation. See background information for more help.) Find out the time it took to evaporate the water and how much salt you got. Weigh the salt. Calculate how much that salt cost. Use the minimum wage to calculate the cost. Find out how much the same weight of salt would cost if you bought it from the market. Is it more economical to buy salt or to make your own? Would you continue to make your own salt for other reasons?

   Save the salt you obtained for the unit on preserving.

3. Students can compare the different types of salts - their salt, Hawaiian salt, rock salt, Morton salt, Leslie salt, Sea salt. Do they all look alike? Do they taste the same? (Be sure the students rinse their mouths after each taste test to insure "true flavor". Do the salts all feel the same? Do they dissolve the same?

   Have the students make a data sheet so that comparison of results and discussion would be easier. Have them think of a few taste words, feel words, etc. before they experiment so that their results would be understood by everyone.

SALT	TASTE	FEEL	SMELL	OTHER
Own salt				
Leslie				
Rock salt				
Morton				
Hawaiian				

   Taste words - sour, bitter, sweet, salty, etc.
   Feel words - bumpy, smooth, sandpaper, etc.

4. Students can grow salt crystals to compare if they evaporate to form the same shape crystals. (Use the microscope for closer examination).

5. Have the students ask their parents what they use salt for? Is it the same as what the Ancient Hawaiians used salt for? What did the Hawaiians use the salt for? For medicinal purposes, flavoring, preserving food.

6. Have the students do one of the following to show understanding of what salt is:

   Make a chart or diorama showing the process of making salt.

   Write a legend on how the ocean came to be and how people got and used salt.

   Write a poem or song about salt. In it, express your personal feelings about salt and if you can live without it.

BACKGROUND INFORMATION:

To make salt, get a gallon of sea water and pour it into a shallow pan. You may cover it with screen or cheese cloth to prevent it from getting it dirty. Place pan in a safe place in the sun. Let it stand in the sun for two to four weeks. The longer you let it sit, the more salt will form. Be sure to take it indoors every night or whenever it rains. If not, the rain or dew will dilute your salt. After a film of salt forms on the top of your sea water, scoop it up with your hand and put it in a cheese cloth bag or colander and let it air dry for a few more days (about 2-5 days). When the salt is thoroughly dried, crush the salt into fine pieces and store in a dry container. Your original gallon of sea water can be used 2-3 times to get salt.

SAlt was used by the Hawaiians for medicinal purposes, preserving food, and for flavoring. Whenever the Hawaiians had a sore throat, they gargled with salt and water. When they had rash or itch, they soaked their body in salt water. When they didn't have food to eat, they drank some salt water to tie them over. Also, the Hawaiians used salt to preserve "old food". Whenever food started to spoil, they sprinkled on salt and dried it in the sun.

Salt is used in their religious ceremony.

In ancient days, salt was gathered from the shoreline where it crystallized naturally on the rocks from the sea water. The Hawaiians collected this salt and stored it in gourds that hung in nets above the ground to keep it clean.

TOPIC: FOOD CONTAINERS (Draft)

OBJECTIVES: The students will:

1. Understand the need for food containers.

2. Gather or construct suitable containers for their "Boatday" food.

3. Experiment to find the "best" food container (that will keep food fresh the longest).

MATERIALS NEEDED:

ziploc bac
tupperware or other plastic container
can with cover
glass jar
cookie or other food

PROCEDURE:

1. Have the students find out why we need to store food. Which would last longer - a cookie on a table or a cookie in an air-tight container? Why?
Which would you eat - a preserved sweet whole seed that has been sitting on a table top for one week, or the same seed that is still in the wrapper for one week? Why?

2. Which container will keep our food fresh the longest - tupperware, ziploc bag, can with cover, glass jar, etc? All the containers should be placed in the sun with the same type of food in it. (At the most, the containers can be placed under a table in the sun...that's how our food will be stored on the day of our imaginary sea voyage.) Also, the food should be in the sun for at least two weeks - that's to simulate a long sea voyage.

3. How did the ancient Hawaiians store their food? Did they have any problems in storing their food? Compare the storage containers of ancient days to today's containers.

4. Students should keep in mind the sun, the space on the ship, and the type of food they're eating when they decide on the kind of food containers they will store their food in on "Boatday".

TOPIC: SUN DRYING FOOD (Draft)

OBJECTIVES: The students will:

1. Predict ways for preserving food.

2. Use their senses of smelling, tasting, seeing, and feeling to compare the food before and after drying.

3. Collect data in tabular form.

4. Analyze and suggest a way of shortening the drying time of at least one type of food.

5. Discuss and practice the need for sanitation rules in handling food. (Show understanding of rules in the manner they set up their work.)

MATERIALS NEEDED:

Cardboard box, bar-b-que sticks, window screen, masking tape, scissors or X-acto knife needed to make a drying box.

Knife and cutting board needed to clean fish and slice fruits.
Trays to hold fish and fruits.
Soap to wash hands and to clean kitchen utensils.
Towels needed to dry hands and wipe kitchen utensils.

Ziploc bags, tupperware, or other air-tight containers to hold dried food.

Drying boxes.

PROCEDURE:

1. This unit can be started in many ways. 3 suggestions are:

   a. Have a class discussion on the Hokule'a voyage to Tahiti. "What kinds of food do you think the Hawaiians took on their trip to Tahiti?" Why did they take that kind of food?

      "Did the people take fresh food on their canoe?" Why couldn't they take a lot of fresh food on the canoe? (The fresh food wouldn't last and they were limited in space.)

      "If the people fished, could they be sure to catch enough fish to feed the crew? If they caught fish, how did they prepare them? Did they eat them raw?"

b. Pass out dried cuttlefish or other naturally dried food---squid, fish, octupus, fruits (banana, raisin, papaya, etc.) Have a discussion on how that piece of dried food came to its present form.
   "What does the food taste like?"
   "Where did it come from or was it always like that?"
   "How was it prepared?"

c. Call Polynesian Voyaging Society and have them send down a resource speaker to demonstrate the process of drying food to your class. OR ask a student's parent to do it.

2. After your introductory discussion, have the students make a list of all the foods they would take on their imaginary sea voyage. (Put the list on the board) Find out which of these foods the Hawaiians took on their voyages and which of them need to be prepared in any way so that the food will last over two weeks.

   Find out how the students want to prepare their food. Possible responses:
   sun dried or solar cooked
   oven dried
   air dried
   seal in air tight container
   buy prepared food from the market
   leave it in the refrigerator

3. Have the students test out their different methods of preserving foods. Let them use BANANA because that would be the most easily accessible food to use. If you have the time and patience, let them try all the wacky ways they want---Hang it in the room, put it on a rock, leave it on a plate in the sun, hang it from the basketball court pole, seal it in saran wrap and put it on the roof, cook it over the stove, hold it in their hands in the sun, etc.

   After they got their food preserved (dried), have them store it for 2 weeks to see if it will last on a sea voyage.

   After their experimentation, find out which process was the most successful---the food should still be edible!!

4. Use the most successful method of preserving food and/or use drying boxes to dry the food for their imaginary sea voyage. Have the students make drying boxes out of cardboard boxes and window screen. (See background information for more help.)

Before the students can actually prepare any food, they need to decide on:

1. How many meals they will eat in 4 hours?

2. How much food and what types of food will they take. Is it going to be fresh or prepared in any way? The food should last over 2 weeks to simulate a real voyage. (Also, remember that we're not having a feast and space is a problem, so we need to take "just enough" food. In a real situation, we would take as much food as possible and ration it to last a long time because we might run into unexpected situations and spend more days on the open ocean than we had anticipated.)

3. How often are specific food items going to be eaten?

Once the menu and quantity of food needed have been established, the students can proceed in preparing the food.

a. Divide the class into small groups, number in each group will depend on the list of food they're preparing. (Each student should be in charge of preparing one food on their list).

b. Go over steps for preparing food.

   1. Fish needs to be scaled, cut open from head to tail, "guts" removed, and salted lightly with Hawaiian salt. Leave the fish salted in the refrigerator for at least one hour before putting it in the sun to dry.

   2. Fruits need to be skinned, and sliced thin - about 3/8 inch thick. The thicker the slice, the longer it will take to dry. No salt is needed for the fruits.

c. Go over some health and safety rules.

   1. Discuss the need to wash their hands before touching food. Hands and arms (up to their elbows should be washed.)

   2. Do not touch body or other unnecessary equipment after washing hands.

   3. Wear hair nets or scarves to protect food from falling hair.

4. Do not cough or sneeze on food.

5. Discuss the proper way to handle a knife. Demonstrate how to cut meat or fruits. Also, discuss the proper way to put the knife down on the table.

6. Set consequences for not following rules.

d. Place food in drying boxes. Be sure students take the boxes out every morning and bring them in after school. (Most food will dry in a week, so you should do all the preparation on MOnday) If it should rain, be sure the students bring the drying boxes in as soon as possible. It's also very important that your drying boxes are closed very securely to keep the "bugs" out. Also, be sure the food isn't touching the sides of the boxes or the screen. Many bugs will suck on the food through the screen.

5. The following scientific investigations can be carried out during the drying process:

a. How long does it take for different foods to be dried?

b. How does the food taste before and after drying?

c. What does the food look like before and after drying?

d. How does the food feel before and after drying?

e. How does the food smell before and after drying?

f. How does the weight of the food differ before and after drying?

g. Do bugs prefer fresh or dried food? Which food do they attack first - fresh or dried?

h. Can you shorten the length of time needed to dry a particular Food? (Try cutting it thinner, drying it in the oven first then putting it in the sun, etc.) food can also be dried in a microwave oven

The students should learn to keep data in a tabular form for easy reference. The following chart could be used.

NAME: ____________________

Food: ____________________

Date*	Weather Condition	Time started (Taken outdoors)	Time stopped (Taken indoors)	Number of hours left in sun

* The date should also show days the food was not taken outdoors due to weather conditions or holidays, etc.

Quality	Before Dried	After Dried	Do you like the quality of the food before or after or no difference?
Taste of Food			
Texture of Food			
Appearance of Food (Color)			
Smell of Food			
Weight of Food			

BACKGROUND INFORMATION:

The ancient Hawaiians salted and dried their fish so that they would have food either when the weather prevented fishing at sea or during the tabu season. These tabu seasons coincided with the fish spawning periods. Therefore, this system prevented the depletion of their ocean resource---their way of conservation.

To dry their fish, the Hawaiians cut the fish open by splitting it through the head and back. They then removed the internal organs, and salted the fish. These fish were then placed directly on hot large rocks in the sun. If the skin of the fish was removed because it was too tough, then the fish was placed on leaves or branches on the hot rocks. Small fish were strung on branches or strong stalks to dry. After the fish were dried, they were stored in calabashes and hung up in nets.

At Maili Elementary School, the teachers used Environmental Education Fund to purchase Halalu (baby akule) from the market to dry. The students brought banana, sweet potato, papaya, and squid to dry.

The cafeteria workers helped the students by cleaning the fish and storing it in the big refrigerator. They cleaned them on a Friday afternoon, salted them, and left them in the refrigerator. On Monday morning, the students took the fish out to dry. We borrowed a large drying box (4 feet by 8 feet) from Alice Froseith, of the Polynesian Voyaging Society, and several students brought drying boxes from home. (The drying box from Alice was too large and difficult to manuver in and out of the classroom). These boxes were placed on student chairs outside our portable classroom. On the average, the fish took 5 days to dry. On the 4th day, the students turned the fish over to dry the back. The fish were a little salty, so before you dry them, it might be wise to rinse the fish.

On Monday, the students also peeled and sliced the banana, and papaya. They then placed these fruits in the same drying box with the fish. These fruits took about 3 days to dry. To be extra sure that they were dried, the students left them out for 4 days. On the 3rd day, the students turned the banana and papaya over to dry the other side.

Its important to remember to slice the fruits lengthwise so you have bigger pieces to work with. And the thicker you slice the fruits, the longer they take to dry.

The sweet potato needs to be steamed, not boiled, till its firm and not soft. It's not necessary to peel the skin off. Slice lengthwise about 3/8 inch thick.

The squid took about 2½ days to dry. To clean the squid, we cut open the squid and took the internal organs out. The students then rubbed the squid with Hawaiian salt to remove the thin slimy membrane. It was then rinsed and lightly salted. We left the squid in the refrigerator overnight because we didn't finish cleaning till late in the afternoon. (The squid is time consuming in cleaning because it is difficult to remove the thin membrane.) The squid were placed in the sun the following morning. It wasn't necessary to turn the squid over because they dried paper thin.

Before storing, be sure your food is thoroughly dried. If not, they might mold on you!!! Also, store the food in air tight containers (Ziploc bags are great) in a cool place were the temperature does not vary drastically. We left our food in our air-conditioned library till "Boatday". Also, you should check your stored food periodically, if any is molding, remove it quickly, if not, it will ruin the whole batch. Mold might develop if there is moisture in the bag. The food could be redried to prevent further molding.

We bought too much food for the student. To calculate the amount you need, figure on ½-½ fish/student, and a few slices maybe 2-4) of each fruit. The quantity of food you serve will vary, depending on the number of different selections available and the number of times you plan to serve them.

RESOURCES:

Aloha Council, BSA, <u>Hawaiiana, A Handbook for Scouts</u>, Hon., Hi, 1973

E.S. Craighill Handy, Kenneth Emory, Edwin Bryan, Peter Buck, John Wise, etc., <u>Ancient Hawaiian Civilization</u>, a series of lectures delivered at Kam School, Charles E. Tuttle, Co., Inc., Rutland, Vermont, 1965.

Polynesian Voyaging Society phone 841-3966

SUN DRYING FOOD

DRYING BOX

MATERIALS NEEDED:

box 8" X 10½" x 12-3/4" (estimated...Hawaiian Sun Juice Box is good.)

glue
window screen or fiberglass screen
X-acto knife
scissors
string or cord
masking tape
ruler
paper clips - 3
paper fasteners - 3
12" bamboo skewers - 20 or more

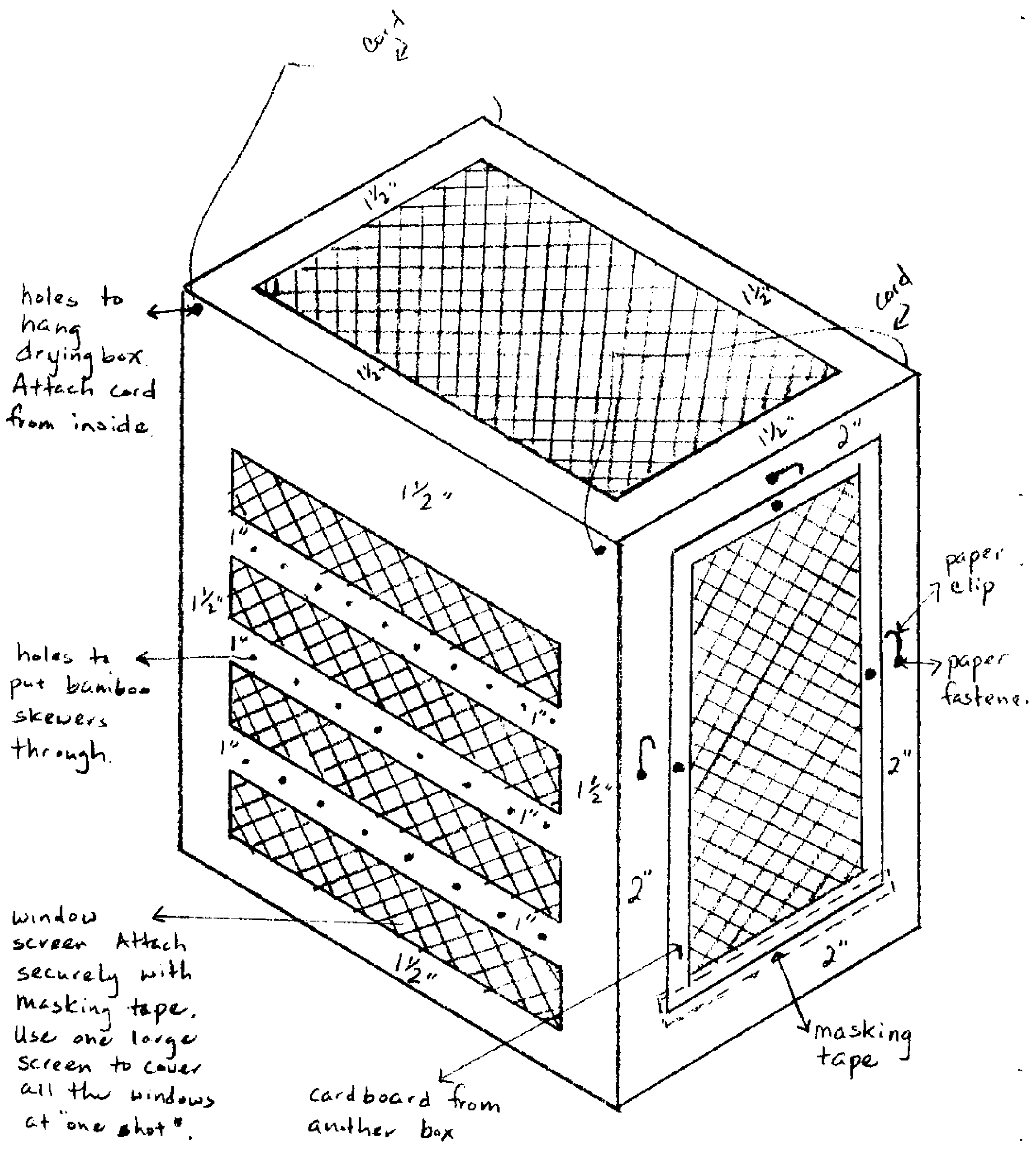
PROCEDURE:

1. To make the sides, cut a lot of "windows" so that air can circulate. Be sure there is at least 1" margin around each window. (See diagram) Tape one large screen on the inside of the box with masking tape. Be sure there are no holes through which the bugs can enter. Make small holes to fit the bamboo skewers (Bar-B-Que sticks). The skewers are the "trays" to rest the food on to dry. The closer the skewers, the easier it is to place the food. Make two small holes on the top to attach the cord so you can hang your drying box up. (See diagram)

2. To make the bottom, top, and back, cut out a large "window". Leave a 1½" margin. Tape the screen on the inside of the box with masking tape. Be generous with the tape.

3. Cut a window on the front side of the box. Leave a 2" margin. Get another carboard that is at least 1" larger than the front window. Cut an opening in this cardboard (the door) with a 1" margin to tape the screen on. Attach the door to the front bottom of the drying box with masking tape. This will be the hinge. Use paper fasteners and paper clips as "locks" to keep the door closed. (Your students might need to improve this door so that the box will be "bug proof".

Drying Box



cord
cord
holes to hang drying box. Attach cord from inside.
holes to put bamboo skewers through.
window screen Attach securely with masking tape. Use one large screen to cover all the windows at "one shot".
cardboard from another box
masking tape
paper clip
paper fastener
1½"
1½"
1½"
1½"
1½"
1"
1½"
1"
1"
1"
1"
1"
1½"
1½"
2"
2"
2"
2"

SUN DRYING FOOD

Food Preparation and Drying

I. Drying

A. Food

1. The Hawaiian cooking banana or apple banana preferred over the chinese banana for drying. Takes a week to dry.
2. Taro- needs to be steamed after cleaned. Don't cut too thin or slice will be hard instead of chewy.
3. Sweet potato- steamed for less than an hour, slice leaving skin on. Takes a week and half to dry or two weeks.
4. Limu Kohu- squeeze out water, dry. To make edible add salt water.
5. Fish- depends on type and size of fish how it is prepared for drying. Cut fan shape-debone-rock salt overnight. Rinse off in the morning with fresh water and put in dry box. Large fish clean and cut up into strips.
6. Squid- fresh squid , clean out head, sprinkle with rock salt pound it to tenderize. Dries in 2 weeks.
7. Breadfruit- steamed and sliced ripe or overripe mash and spread as thin cookie.
8. Coconut- used as food-drink-fuel for fire
9. Ferns- very young shoots edible
10. Ti plant- for wrapping foods and parts are edible

B. Dry Box

1. keep bugs and dirt out
2. turn food over every other day

C. Store

1. plastic bags , cool place. Lasts 6 months to a year.
2. Can be frozen but has to be redried because picks up moisture in the freezer.

SUN DRYING FOOD

RECIPES FOR POLYNESIAN VOYAGING SOCIETY'S

FOOD PROJECT

1. Mai'a (Banana). Select firm-ripe mai'a with slight green tinge remaining on skin. Peel and slice lengthwise into three or four strips. Arrange on drying rack, turning once a day. Dries between four and fourteen days depending on area, faster drying occuring in Makaha and slower drying in Manoa. Do not be concerned with the change of color of the mai'a during the process of drying. Mai'a is ready when consistency resembles dried apples.

2. Uala (Sweet•Potatoe) and Uhi (Yam). Rinse and cook, preferably by steaming. Test for readiness by piercing with fork, do not overcook. Let stand to cool, then slice into ½ inch pieces, arrange on drying rack, turning once a day. Dries within three to four days.

3. Ulu (Breadfruit). Select ulu which has reached the o'o stage of ripeness, picking those still on the tree. Ulu has reached the o'o stage when white sap appears on skin of fruit, as well as 'browning' of the skin. Bake for 1½ hours, or, steam for one hour, let cool. Remove skin and seeds, mash into pulp. Spread on sheet of wax paper, place similar length of wax paper over ulu pulp. Using rolling pin or bottle, spread ulu out as you would when preparing dough for pie. Remove top wax paper, place ulu on lower wax paper together on drying rack, saving the other piece of wax paper for later. When surface of ulu dries, turn entire sheet of ulu onto the first wax paper, repeating until drying process is complete, turning once a day. Dried ulu assumes a deep reddish brown color when dried, takes four days in hot area to dry completely. Take one end of dried ulu, tuck in and roll as you would a jelly-roll. Wrap in saran wrap.

4. Kalo (Taro). Wash and cook thoroughly, preferably by boiling Best to leave skin on while cooking, removing skin as soon as kalo is cooked and cool enough to handle. When dried after pounding, kalo is similar to hard-tack, especially if rolled out into thin layers or sliced.

   To prepare pa'i 'ai, follow the above cooking instructions, wet board and pounder lightly with water. With even strokes, begin mashing kalo while still warm from cooking, producing a doughy mass. Lightly wet board and pounder to prevent sticking, being careful not to use too much water, the less the better. Be sure to mash thoroughly so you have a smooth, heavy poi. Fermentation of pa'i 'ai acts as a preservative, as it does in regular poi, the process of fermentation being much slower in pa'i 'ai.

5. I'a (Fish). The preparation of I'a and He'e are exerpts taken from a contribution made by David K. Roy of Kona to the P.V.S in May of 1974.

Immediately after catching, the fish should be kept cool and under cover. As soon as possible, after catching, cut and salt fish for drying. Fish are cut on one side of dorsal line through the head, leaving the belly line intact. If fish are large, cut through bones parallel to spinal column, and cut flesh to allow salt to penetrate. Spread open the cut fish, remove gills and viscera and the coagulated blood along the spinal column and wash the cavity clean. Hawaiians in the past, rubbed the exposed flesh on both cut sections with the blood. Slap the cut portion onto the salt which should then, being about even distribution over the exposed flesh. The skin section need not be treated in this manner as it will receive an adequate amount when the fish is stacked in the container. Place the fish in a wide container with the salted portion down, and stack in layers as evenly as possible. The fish in each layer should be laid vertical to those on the bottom layer. After all the fish have been salted, place container under cover and allow to stand overnight. The next morning the salted fish should be washed thoroughly and soaked in water for one or two hours. During this period the water should be changed approximately two or three times. When salt can barely be tasted, fish is ready for drying.

6. He'e (Octopus). Keep freshly caught he'e cool and damp. Before drying, the ala'ala (ink bags) are removed and salted for drying (usually to be used for other purposes although it is used as a flavoring ingredient when prepared for raw consumption). The he'e is thoroughly pounded with approximately two handfuls of salt and more added as it dissolves. The pounding is done in an up and down motion and involves grasping the central or head portion and pounding it on the rest of the body and tentacles. After as much as seven hundred strokes and intermittent washing, the whole becomes tender enough so that the flesh tears easily with a minimum of effort. The pounding process in salt serves tow purposes; 1) the removal of mucous, and 2) tenderizing. After pounding and rinsing off the extraneous matter, the he'e is hung up to dry for approximately three or more days.

7. Ko (Sugar Cane). Select mature cane which has not begun to 'sproat', cut at base and bottom of leafy top. Wrap exposed ends to prevent cane from drying out. Store in cool, dry place. Cut off bark and cut again in stick-like pieces for eating.

8. Niu (Coconut). Life expectancy of fresh niu is quite good, the entire nut being useful as food, drink and fuel. The a'a niu

is used to wrap things and substitutes for toilet paper, is not as rough when wet.

9. Limu (Seaweed). Clean and wash well, set out to dry. Takes one to two days for drying. Reconstitute with water when ready to eat, sea water being acceptable.

10. Kukui Nut (Candlenut). Remove outer husk and roast in barbecue pit over medium coals or in oven at 350 degrees for about one hour. Crack shell, remove nut, mash with rock salt. Use as a flavoring in raw fish dishes. Oil of the nut serves as light fuel and body oil to prevent sunburn.

(The following recipes have not been included in our main diet simply because there hasn't been enough time, and for the ti and hapu'u, access to large quantities has been severely limited. In addition, ti and hapu'u, according to David Malo, were considered famine foods. As such, the ti and hapu'u will be taken in limited amounts.)

11. Pepeiee Ulu (Breadfruit and Coconut Cream). Coconut cream may either be the commercial variety or made by grating ripe coconut meat. Cover with warm water, let set, then squeeze through fine sieve. Liquid is coconut cream. Thoroughly mash very ripe ulu, mix in a great deal of coconut cream, wrap in ti leaves and cook thoroughly. Try oven set at 350 degrees, bake until firm. Cool, slice and dry in sun so that a hard oily film forms on the surface.

12. Ki or Ti. Cut the top from plant two to four feet long (plant the upper woody part somewhere else for future use). About the time it starts to sprout, add new leaf buds, and not more than three months after cutting the the top of the stalk. Wrap in green ti leaves and cook. Try the lowest temperature setting on your oven. Cook 24 hours. Dry.

13. Hapu'u or 'ma 'uma'u (Ferns). Take the butt ends of the fern stalk and cook. When cool, store any place and try once a week for four weeks.

RECIPE CREDITS

Items 1 through 4, 7 through 10 are results from experiences of Mrs. Alice Moku Froiseth and Mrs. Paige Kawelo Barber.

Items 5 and 6 are contributions made by Mr. David K. Roy of Kona.

Items 11 through 13, and initial research of this food project was prepared by Mrs. June Gutmanis.

TOPIC: WATER (Draft)

OBJECTIVES: The students will:

1. Know how to ration water.
2. Find suitable container to store water for their imaginary sea voyage.

MATERIALS NEEDED:

Plastic Jar
Glass Bottle

PROCEDURE:

1. Have a discussion with the students on where the Hawaiians obtained their water when they were on land and out on the ocean.

   If you were stranded out at sea in a boat, how would you get fresh water? Try an experiment to get fresh water from salt water. How would you catch rain drops?

2. How long can you last without water? Can you last for one hour without water? Two hours? Three hours? Four hours?

   If you had a very limited water supply, what can you do to keep from dehydrating?

3. Where would you store water if you were taking a sea voyage? Does water taste the same in plastic containers and glass jars?

4. Store some water in a plastic container and glass jar. How does the water taste after it has been stored in these containers for one week? For two weeks?

   After doing this experiment, where would you store water for your imaginary sea voyage? Knowing that space on a boat is limited, how much water would you bring on your imaginary sea voyage for your entire class for four hours? Think of the minimum amount your class need for the voyage.

SUPPLEMENTARY ACTIVITIES:

1. Find out how much of our body is made of water.

2. Does meat contain water? Weigh a small piece of meat. Pulverize it or smash it to take as much liquid out as possible. Weigh the meat again. Why was there a weight difference, if any?

3. Does a fish have water in it? Remove the "guts" from a fish. Put the fish in a blender. Blend till fish is in small pieces. Place fish pieces in a cloth and squeeze. Does water come out of the fish?

UNIT: CLOTHING (Draft)

OBJECTIVES: Students will be able to:

1. Read a thermometer correctly.

2. Analyze data and infer how temperature affects our behavior.

3. Suggest the proper type of clothing to wear on "boatday".

MATERIALS NEEDED:

1 thermometer per student

PROCEDURE:

1. Have the students take the temperature at various locations in school --- outside the room, in the room, under a tree, in the middle of the playfield, at the basketball court, in the parking lot, etc. (If the students don't know how to read a thermometer, see backgroud information)

   Before they go out to take the temperature, have them suggest several ways of recording their data. After a discussion, let them choose the "best way" to record their temperature. If they cannot think of a way, suggest that they make a tabular form:

PLACES	AM time	Weather Cond.	PM time	Weather Cond.*
Courtyard				
Under tree				
In room				
Outside room				
Playfield				
Basketball Court				
Parking lot				

*Students should make a list of different weather conditions --- cloudy, overcast, clear sky with few clouds, sunny/no clouds, rain, shower, windy but hot,etc. ---this would make comparison of information easier.

If your students are very interested, you can try comparing the temperature one (1) inch above the ground and three (3) feet above the ground.

2. Look over the data and discuss how temperature can affect their behavior. How do they feel in the morning? How do they feel in the afternnon? Not only the temperature, but the weather must be considered. If we were going to take an ocean voyage, what kinds of physical conditions and weather must we protect ourselves from? (Wind, rain, sun, ocean) Could we improve our feelings by the way we dress? If so, what type of clothing would you wear on your imaginary sea voyage? See background information

SUPPLEMENTARY ACTIVITIES:

1. Make clothing that the Hawaiians wore --- Tapa and sandal making. Possible sources of help would be students' parents or Kam School Extension Service.
2. Make a waterproof covering from natural materials. (Use ti leaf, lauhala, banana leaf, etc.) Have students design some tests for water proofing.

BACKGROUND INFORMATION:

When the students use a thermometer, remind them not to hold the thermometer by the "bulb". If not, they will be taking the temperature of their fingers instead of the air. Also, they need to read the thermometer at "eye level". The students should realize that the mercury column need to stabilize before they can take their reading.

For our boatday last year, the students were told to wear shorts and short sleeve shirts. They were recommended to bring a hat and long sleeve shirts to protect themselves from the sun. We told them to think about the possibility of rain and what they were going to do to protect themselves. Also, the students went barefoot that day.

Hopefully this year, the students will be able to suggest the proper type of clothing for thier imaginary sea voyage. After their experiment on temperature, the students should discuss and make a list of the type of clothing they would wear. Have them wear the type of clothing they suggest in a practice session. Do they want to change their list? If so, let them and find out why they made some changes. Keep the list of clothing for use on "boat day".

RESOURCES:

Titcomb, Margaret, THE ANCIENT HAWAIIANS, How They Clothed Themselves, Hogarth Press-Hawaii, Inc., 1974.

STUDENT PRE-POST TEST

	Easily	Pretty well	So-So	Not at all	Don't under-stand the state-ment	Comments
1. I can find North on a sunny day.						
2. I can use a sail model to show that a boat can sail in a direction other than the way the wind blows.						
3. I can follow the phases of the moon.						
4. I can describe different migrations from Polynesia to Hawaii.						
5. I can sail a model boat made of found materials.						
6. I can find Polaris (Hokupa'a) and Arcturus (Hokule'a) at night.						
7. I can load a model canoe so that it doesn't tip over.						
8. I can float fresh water on salt water.						
9. I can tie a knot that will connect two pieces of rope.						
10. I can explain how the moon influences the tides.						
11. I can sun dry food.						
12. I can collect information in tubular form.						
13. I can explain why we need sanitation rules in handling food.						
14. I can properly use a simple balance.						
15. I can identify at least three seaweeds.						

STUDENT PRE-POST TEST

	Easily	Pretty well	So-So	Not at all	Don't under-stand the state-ment	Comments
16. I can make a tray out of coconut leaves.						
17. I can make a bowl out of a coconut shell.						
18. I can make a crab or fish catching device .						
19. I can read a thermometer.						
20. I can get salt from sea water.						
21. I can describe what type of clothing to wear on a boat.						

POST TEST INFORMATION:

1. Which activities/lessons did you enjoy doing?

2. Which activities/lessons did you not enjoy doing?

3. What things would you like to change, exclude, or include to make this unit a better one?

SECTION B

SEAMANSHIP

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SEAMANSHIP

The activities under the following topics may be used whole or in part as preparation for the final "Boat Day" activity. For all activities covered, the students should keep a log or notebook written and/or pictorial. They should also make a list of at least three words describing their feelings about the activity which may be used as the basis of a story or poem.

Table of Contents

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Topic: Direction

Objectives:

The students will:

1. Learn to find the general directions north, south, east and west based on the position of the sun and time of day.

2. Use this knowledge to find north in their own homes.

3. Keep a record of sun shadows to show:

   a) the change in the position of the sun through the year OR

   b) the change in the apparent position of the sun during the day.

Materials Needed:

Globe or map of the world, large piece of cardboard of oaktag about 36" x 36", meter stick, marking pen, rod or stick approximately 18" in height and a plumb bob or any weighted string which can be used to find the vertical.

Procedure:

1. Ask the class about direction. How do you know where something is located? How can you tell someone else? How do you tell how to find an object that you can't see? What common Hawaiian direction words do we use? (makai, mauka, Ewa, Makaha, Kaimuki, etc.) Why are these terms good only on land? What if you can't see land? On the open ocean, you need another way to tell directions.

2. Some of the students will mention north, east, south and west. Ask them how to find these directions. Probably someone will say to use a compass. Tell them to think of the ancient Polynesians who had no compass (we'll come back to the compass later). How could they tell north from south, east from west? The Polynesians, as well as modern navigators, can tell by observing the sun and stars, moon and planets.

3. The sun is in the eastern part of the sky until noon and is in the western part in the afternoon. A shadow in the morning, then, would generally point west (away from the sun) and a shadow in the afternoon would point east, away from the setting sun. At noon, twice a year, there is no shadow from the sun. The rest of the year the shadow is small. An observer standing outside in the morning will then cast a shadow towards the west. If the observer stands so that the left side of the body points in the direction of the shadow, the right side will point east. In the afternoon, the right side should point towards the shadow, or east, and the left will still point west. Try it!

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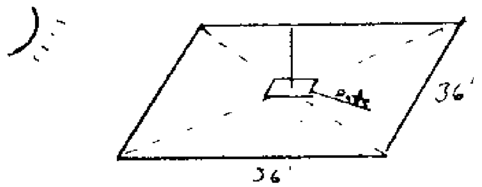
4. Inside, have the students look at a map or globe. If the left side of the map is west, what direction is represented on the right side of the map? Which way is "up" on a map? What is this like if you are outside? North is not "up" when you are outside! If your left side points west, your right side points east, then you are facing in the general direction of north. Which way does your okole point? (south)

5. Keep a record of the shadow of the sun. Lightly pencil in the diagonals on a large sheet of oaktag or cardboard. You now can find the center. Find a fairly level spot. To be consistent, always place the paper in the same place when taking measurements. Find the vertical with a plumb bob. Always put the upright (vertical stick) as close to the center as possible (draw the outline of the base on the paper) so that all shadows start from the same place. You can now keep a shadow record in two ways:

   a) Short duration (such as on the final "boat trip"). Set up your equipment in the morning and use a meter stick and marking pen to trace the shadow every 15 or 30 minutes. Several colors of pens are useful, since the shadow will get shorter, then longer.

   b) Each day or once or twice a week, measure the shadow as in a) EXCEPT IT MUST BE AT THE SAME TIME OF DAY for each measurement. For example, if your class starts by marking the first shadow at 10:00 a.m. on Tuesday, the next measurement should also be made at 10:00 a.m. regardless of day. The date should be written above each shadow line in pencil to keep a record.



6. A homework assignment which may be used later in the unit on stars: ask students to do procedure 3 at home, to locate east, west, north and south. Some sort of landmark in the general direction of north should be remembered. The students may report back to the class on their progress.

Background Information:

The sun rises in the east and sets in the west due to the daily rotation of the earth. This is not due east nor west because the earth is tilted slightly. The sun seems to drift towards the north from about December 22 to June 20, then towards the south from June 21 to December 22. December 22 and June 21 are the shortest and longest days in the Northern Hemisphere. On March 21 and September 23 the days are equal in length (there is some variation in some years).

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Compasses: Unless one is willing to spend a few extra dollars, there is little point in obtaining a compass. A good gimbal mounted compass costs $30 +. Some of the hand-held models for Boy/Girl Scouts are fairly reasonable.

References:

Webster Division, McGraw Hill: Elementary Science Study
<u>Daytime Astronomy</u>
<u>Mapping</u>
<u>Making Maps</u> (goes with above)
<u>Light and Shadows</u>
Rand/McNally: Science Curriculum Improvement Study (SCIS)
Physical Science, <u>Relativity of Place and Motion</u>

jdb

Topic: Wind Direction

Objectives:

The students will:

1. Learn the "in-between" directions NE, NW, SE, and SW.

2. Learn the direction from which the wind blows using a home-made wind vane.

3. Learn the direction the wind is going by using a tell-tale or lei moa.

4. Keep a record of wind direction to be made with Procedure 5 on sun shadows.

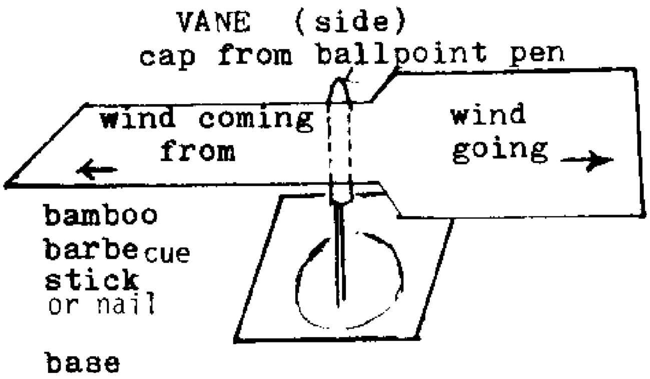
Materials Needed:

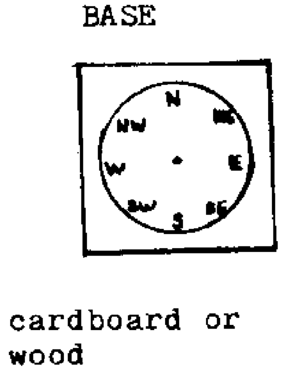
Thin string or thread, oaktag, tape, cardboard base, glue, bamboo barbecue stick or thin nail, cap from old ball point pen, paper clips or other weights, marking pens.

Procedure:

1. Ask the students what happens if the wind is coming from a direction between north and east. How can this direction be described? What if it's between south and west? Introduce the "in-between" directions northeast, southeast, southwest, and northwest; if the class is interested, the "in-betweens" of the "in-betweens" such as north-northeast, south-southwest, etc. can be introduced. This is possibly a good time to show the students the compass rose, showing these directions, if you haven't already done so.

2. Make a wind vane. This is ideally a student project but plans are given below if this cannot be done. The challenge to the students is to make a device (weather instrument!) that will show wind direction. This can be in class or homework. Provide the materials above in either case, as some students can't get some materials at home. If this is not practical, here is a plan that will tell students where the wind is coming from:





Three or more thicknesses of cardboard are best to add stability. Glue them together and glue the stick in place in the base. Use paper clips or other weights to balance the front. In the wind, the arrow points to where the wind comes from.

3. Same idea as 2, but a tell-tale gives an indication of where the wind is going, which is very important for sailing. A string or thread can be tied on an upright by itself or be tied to the one on Procedure 2.

   To use the above instruments, find a place outside where there are no nearby buildings to interfere with the wind. Refer back to the unit on direction -- find north, point the N on the base to north, and read the wind direction by naming the direction at which the arrow of the wind vane points (the opposite of the way the tell-tale is pointing on the base of the instrument).

4. Have the students keep a record of the daily/hourly/weekly wind directions. This can be done in conjunction with the shadow records. The students might also keep other weather data such as temperature, cloud coverage, humidity, general observations. Perhaps some patterns or correlations will be noticed; i.e., wind/temperature, very cloudy/lower temperature, etc.

Background Information:

Wind is rarely constant. It changes frequently and often rapidly methods above are only for approximation. Here in Hawaii, we generally have wind from the northeast, the tradewind. Sometimes, the wind comes from the southwest, which we call "Kona wind". This is not the only way the wind ever blows, especially since local conditions such as a mountain or storm can change wind direction. Most weather warnings or wind directions are in terms of where the wind is coming from; i.e., the storm Northeaster, which comes from the northeast. On a typical sailing vessel including the Polynesians, the tell-tale is used to show where the wind is GOING.

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Topic: Sailing

Objectives:

The students will:

1. Learn that wind is an energy source.
2. Use a model sail and wind source to find how close into the wind a vessel might sail.
3. Learn that a sailing craft can go in a direction other than the way in which the wind is blowing.

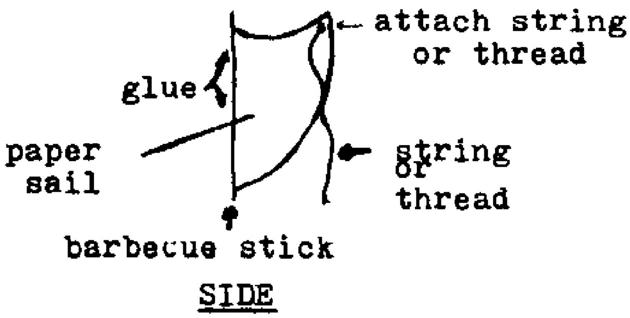
Materials Needed:

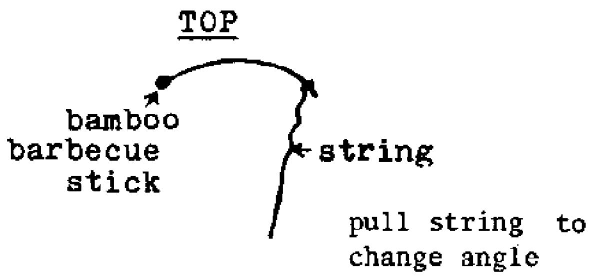
String or thread, 8" bamboo barbecue sticks, sail cut-out (next page), glue, scissors, fan or other wind source, points of sail handout.

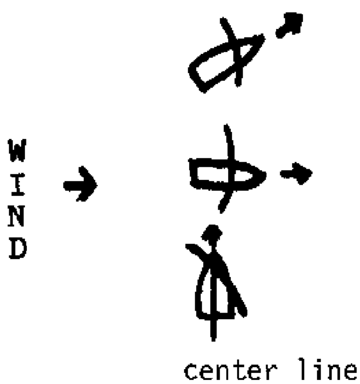
Procedures:

1. Begin by asking students what wind can do: cool us off, turn a windmill, blow leaves, etc. Ask about windstorms such as hurricanes and tornadoes. Wind exerts a force which can do helpful as well as harmful things. We need wind for things like soaring birds, gliders, kites, hang-gliders, bringing us clouds/rain; the list is long. We get something from the wind. The wind gives us ENERGY. Since wind gives us energy, we call wind an energy source. Name some other energy sources: sun, electricity, muscle, etc.

2. Have the students cut out the sail pattern on the next page. Glue the straight edge to the bamboo stick. When dry, attach a string or thread at the star. The sail can now be pulled without moving the "mast". Use a wind source such as a stiff breeze or a fan to try different positions for catching the wind.







With the wind coming at an angle behind the boat it is possible to sail across the wind.

WIND

With the wind directly behind the boat, the boat moves in the same direction as the wind.

Make the angle of the sail to the center line of the boat 45° and the boat can sail perpendicular to the wind.

Can you sail into the wind?

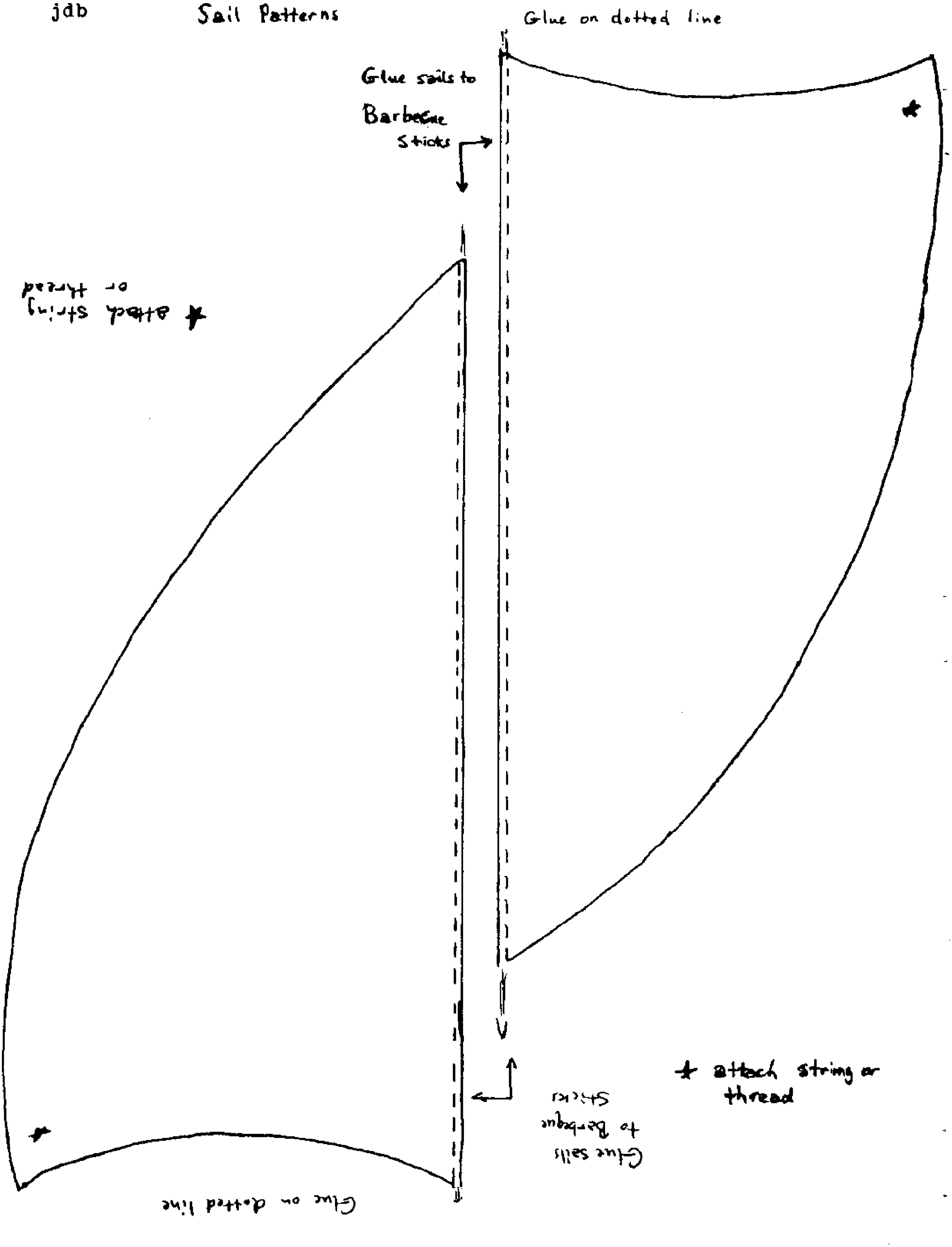


Figure 1. Sail Patterns

What you don't want to happen is to have the sail flap!

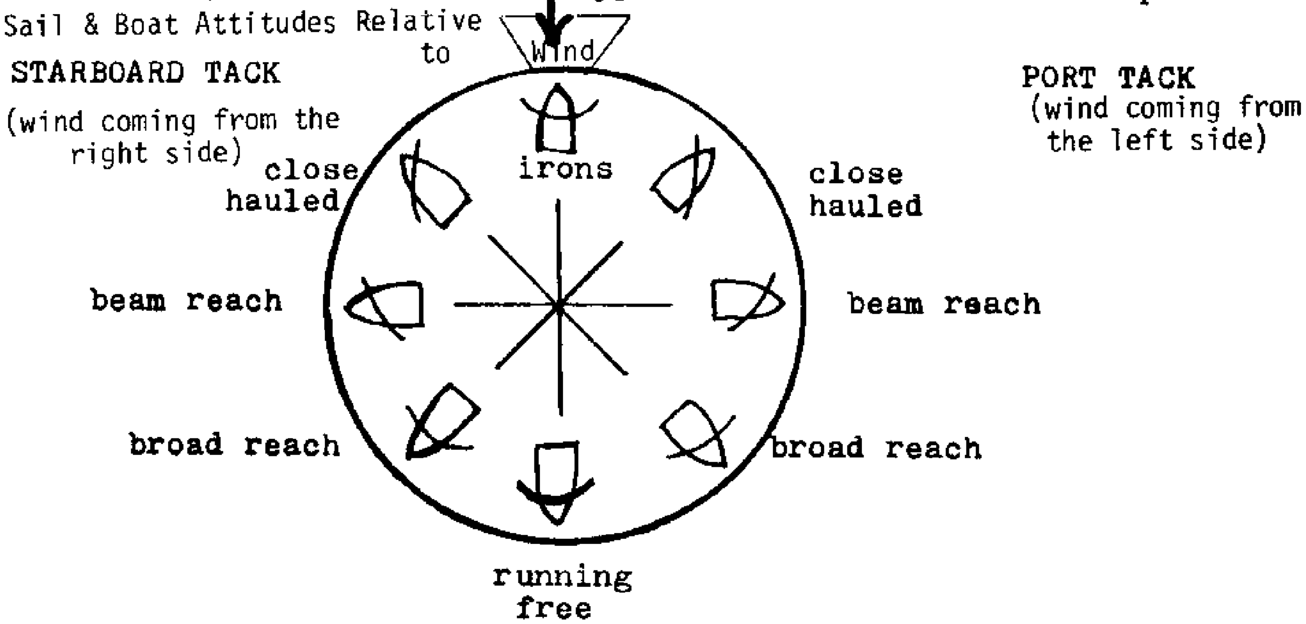


Figure 2. POINTS OF SAIL

3. Figure 2 can show you how you can sail in directions other than that in which the wind is blowing. If you go too close to the wind, the sail will start to flap, losing energy, i.e., forward motion. Sailing directly into the wind will push the boat back.

Background Information:

The wind (makani) pushes the boat. It supplies the energy to push the boat forward. You cannot sail directly into the wind --the best you can do is about 45 degrees on either side of the wind direction.

Many "scholars" said it was not possible for the Polynesians to deliberately sail their canoes to Hawaii because they lacked a keel, or stabilizer. Against the tradewinds, they had to sail very close-hauled. Obviously, "Hokule'a" proved that it was possible.

References:

Apo, Peter: Student handouts for Ho'iana Ike Kai, school year 1978-79, Maili Elementary School

Chapman: Piloting, Seamanship, and Small Boat Handling, 1974

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Topic: Sun and Moon Paths

Objectives:

The student will:

1. Understand the apparent motion of the sun and moon relative to the earth.

2. Know the real motion of the earth relative to the sun.

3. Understand the real motion of the moon relative to the earth.

Materials:

A model of the solar system, the earth, sun, moon combination model (the best); the old light bulb, orange, and toothpick model if it's all you have; a globe and a model moon.

Procedures:

1. In Unit 1, procedure 3 Direction, the students found east and west based on observations of the apparent rising and setting of the sun. A similar procedure can be carried out at night using the moon instead of the sun DURING CERTAIN LUNAR CYCLES (sometimes the moon is visible in the daytime, for example). The students should be aware that the sun and moon seem to move from east to west.

2. Use a model planetarium or globe and light bulb to show the real motion of the earth around the sun. The earth not only turns on its own axis, causing night and day, but also revolves around the sun in a year's time. The turning on the axis causes the sun to seem to rise in the east and set in the west. More important to planters and navigators is the revolution around the sun. On page 2 of the unit on direction, it is mentioned that the earth is tilted slightly (23½ degrees). This tilt causes the seasons. The sun has northern and southern limits as a result of this tilt (Tropic of Cancer and Tropic of Capricorn, both the same 23½ degrees from the equator). This can be demonstrated using models easier than it can be explained. A look at some of the reference material should help.

3. The moon revolves around the Earth while the earth revolves around the sun. The sunlight reflects off the moon, which we see as moonlight so moonlight is really sunlight. The phases of the moon are from these various motions and the light reflecting towards us. The phases are illustrated below:

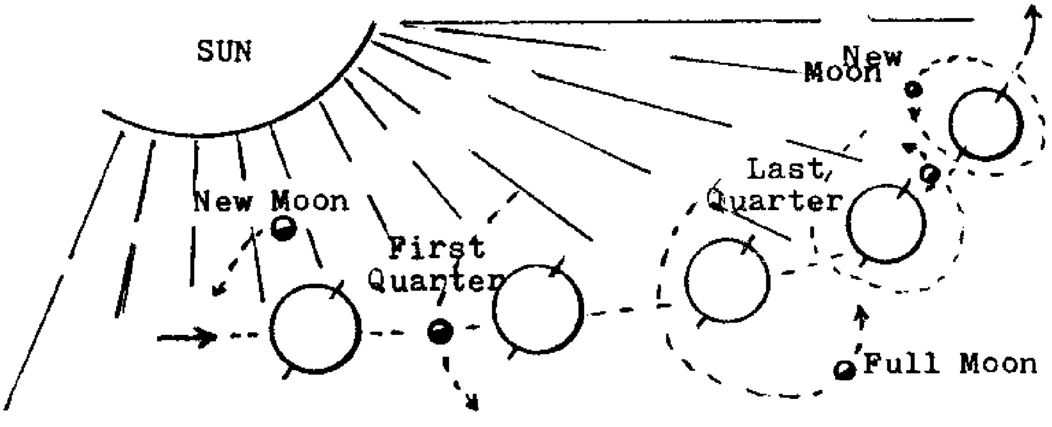

Figure 1. Moon Phases

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Sun and Moon Paths : continued

The observer from earth would see:

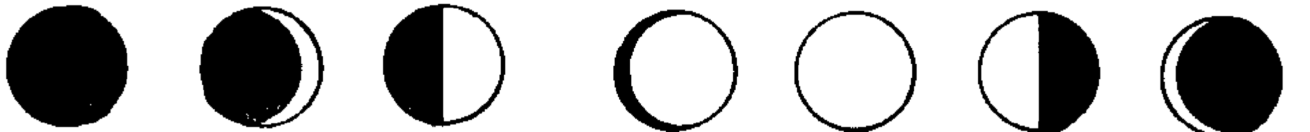


Figure 2. Moon Phases

The moon's revolution around the Earth causes changes in the tides by varying the gravitational pull.

Background Information:

Much information is in the preceding section. The Hawaiians were very much aware of the solar and lunar cycles. The sun path was important to the navigator (Tropic of Cancer - Ke Alanui Polohiwa a Kane, the glistening black path of Kane and the Tropic of Capricorn - Ke Alanui Poloh iwa a Kanaloa, the glistening black path of Kanaloa). He could tell what stars to expect to come up on the horizon by time of year as well as by latitude, a skill still used by modern navigators. The lunar cycle was, and is, more for the farmer. The lunar calendar told them when to plant or not to plant certain crops. The farmer's almanacs of today do the same thing. See references below.

References:

Related E.S.S. Units (McGraw-Hill, Webster Division)
*Where is the Moon?
Where Was the Moon?
Daytime Astronomy
Light and Shadow

Information Please Almanac Golenpaul Assoc.
Mother Earth's Almanac Mother Earth News, Hendersonville, N.C.
*Rey, H.A. The Stars Houghton Mifflin, 1970
Bryan, E.H. Stars Over Hawaii Petroglyph Press, 1977
*Planting Calendar (not correct title) Prince Kuhio Hawaiian Civic Club

*Most informative

jdb Sun and Moon: Other Activities

Literature:

There are many legends from many cultures about the sun and moon. Here is a good opportunity to introduce some of the stories from around the world:

Polynesia:
"Maui Captures the Sun," various creation stories, figure seen in the moon.

Japan:
Moon goddess, Rabbit in the moon (not man in the moon).

Europe:
Icarus flying too close to the sun, Werewolves!, druids, witches, man in the moon.

Asia: ?
Philippines: ?
American Indian: ?

Ask the students to find stories and legends about the sun and moon in the library and especially at home.

Poems:

Make a class collection of poems OR write own.

Art:

Make ceramic or paper mache models to show relative size of moon to earth.

Draw what you might think the inside of a lunar crater looks like.

Draw the earth from the moon.

Music:

There must be some sun and moon songs that can be dug up!

jdb

Topic: Polynesian Migration

Objectives:

The student will:

1. Learn that there was a series of Polynesian migration to Hawaii.
2. Learn that the first migration was most likely from the Marquesas Islands and that the second was probably from Tahiti.

Materials:

Two reproduced handouts for the students.

Large wall map of the Pacific or overheads of the student material.

Procedures:

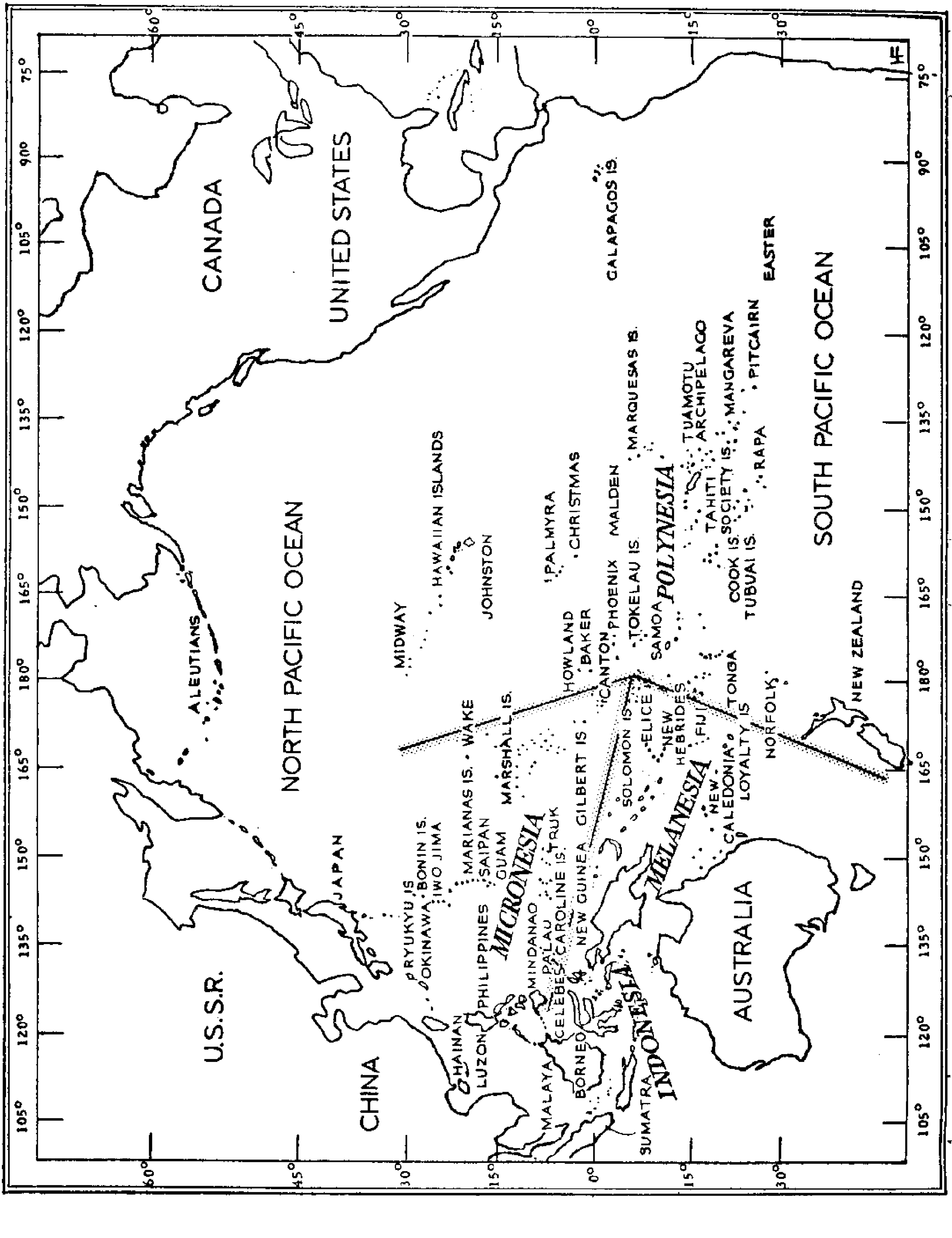
1. Help the students to find Hawaii on the Polynesia map. The overhead projector is good for this as they can follow along. Next help them find Polynesia and go over the general boundaries. Go back to the direction unit and ask which way some of the Polynesian islands are relative to Hawaii. Which one is the most southerly? What is the furthest west? East? etc.

2. Dr. Mitchell's chart shows migrations other than those to Hawaii. Ask the students to trace along to see that there was most likely more than one migration. Hawaiian legends and chants speak of something to this idea. Can anything be found to support this? What about the Menehunes? Could they have been Marquesans? Point out the time difference of the two migrations. Can they think of some reasons why there is such a large gap? Here's a great opportunity for creative writing or oral storytelling. If the Marquesans went to Tahiti and then Hawaii, then later Tahitians went to Hawaii, then what happened?

3. Geneology Game by Peter Apo:
The students are to be in groups of ten, representing ten generations. They are to line up so that the ten generations are ready to pass information from the past to present. The task is for each student (generation) to pass on a message to the next "generation" so that the content does not become lost. The actual words may be different, but the message must be the same. The message may be simple; i.e., "The Polynesians sailed great distances in their double-hulled canoes"; "The Hokule'a showed the world that Polynesians could find the way"; It could be more complex.

Background Information:

General:
The best background information would be to go directly to the library and do some reading. The topic is too extensive to condense.


CANADA
UNITED STATES
U.S.S.R.
CHINA
NORTH PACIFIC OCEAN
SOUTH PACIFIC OCEAN
AUSTRALIA
NEW ZEALAND
ALEUTIANS
JAPAN
HAINAN
LUZON
PHILIPPINES
MINDANAO
MALAYA
BORNEO
SUMATRA
CELEBES
PALAU
NEW GUINEA
RYUKYU IS.
OKINAWA
BONIN IS.
IWO JIMA
MARIANAS IS.
SAIPAN
GUAM
CAROLINE IS.
TRUK
MARSHALL IS.
WAKE
GILBERT IS.
HOWLAND
BAKER
CANTON
PHOENIX
TOKELAU IS.
ELLICE
SOLOMON IS.
NEW HEBRIDES
NEW CALEDONIA
LOYALTY IS.
FIJI
TONGA
NORFOLK
SAMOA
MIDWAY
HAWAIIAN ISLANDS
JOHNSTON
PALMYRA
CHRISTMAS
MALDEN
MARQUESAS IS.
TUAMOTU ARCHIPELAGO
TAHITI
SOCIETY IS.
COOK IS.
TUBUAI IS.
RAPA
MANGAREVA
PITCAIRN
EASTER
GALAPAGOS IS.
MICRONESIA
POLYNESIA
MELANESIA
INDONESIA

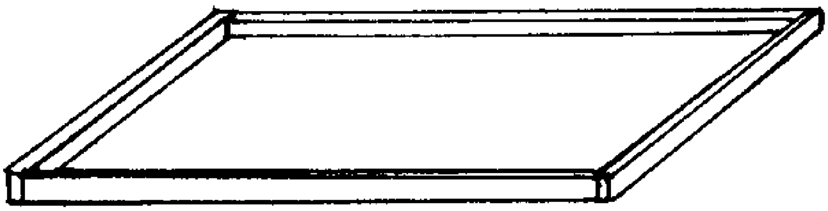
djb

"Junque Boat" Activity:

As much as possible, this should be a student directed activity. The decisions on materials, design, and construction techniques are theirs. At this point there is no right way for them, but a time to explore use of material, etc. Failures are to be expected, but they will get another chance to utilize the knowledge gained from their experiments and the experiments of peers. Let them run the show!

If there is no access to a pond or ocean, make your own.

Make a frame of 2 X 4's or use blocks from Kindergarten. A pond (ocean!) from 4' by 8' to 10' by 12' can handle the output from your classroom shipyard easily. Lay a piece of plastic such as a painter's drop cloth over the frame. The plastic should be at least 3 mils ($\frac{3}{1000}$")thick and extend a foot over each edge of the frame (a 10' x 12' ocean requires a 12' X 14' sheet of plastic). Drape the plastic over, tuck under the frame, fill with water, and instant ocean. It can be aligned north/south or whatever your conditions allow.



Objectives:

The students will:

1. Construct a boat with a sail from found materials.

2. Sail the boat on a suitable body of water (pond, ocean, pool, artificial pond, etc.) as either an individual project or in competition with other students (boat race).

Materials:

Student found materials (from school or home) string, glue, scissors, pond or ocean (supplied by teacher).

Procedures:

1. Decide whether or not this is a school or home project. In either case, the rules are: (1) The materials are FOUND, not bought. (2) The boat must have a sail. (movable sail optional - also a rudder).

2. If this is a competition, it is possible to include some categories that are non-sailing like best looking, most original, largest, smallest, widest, etc. Sailing categories could include fastest, longest afloat (most students don't know that glues like white glue dissolve in water), carries the biggest load, etc.

jdb

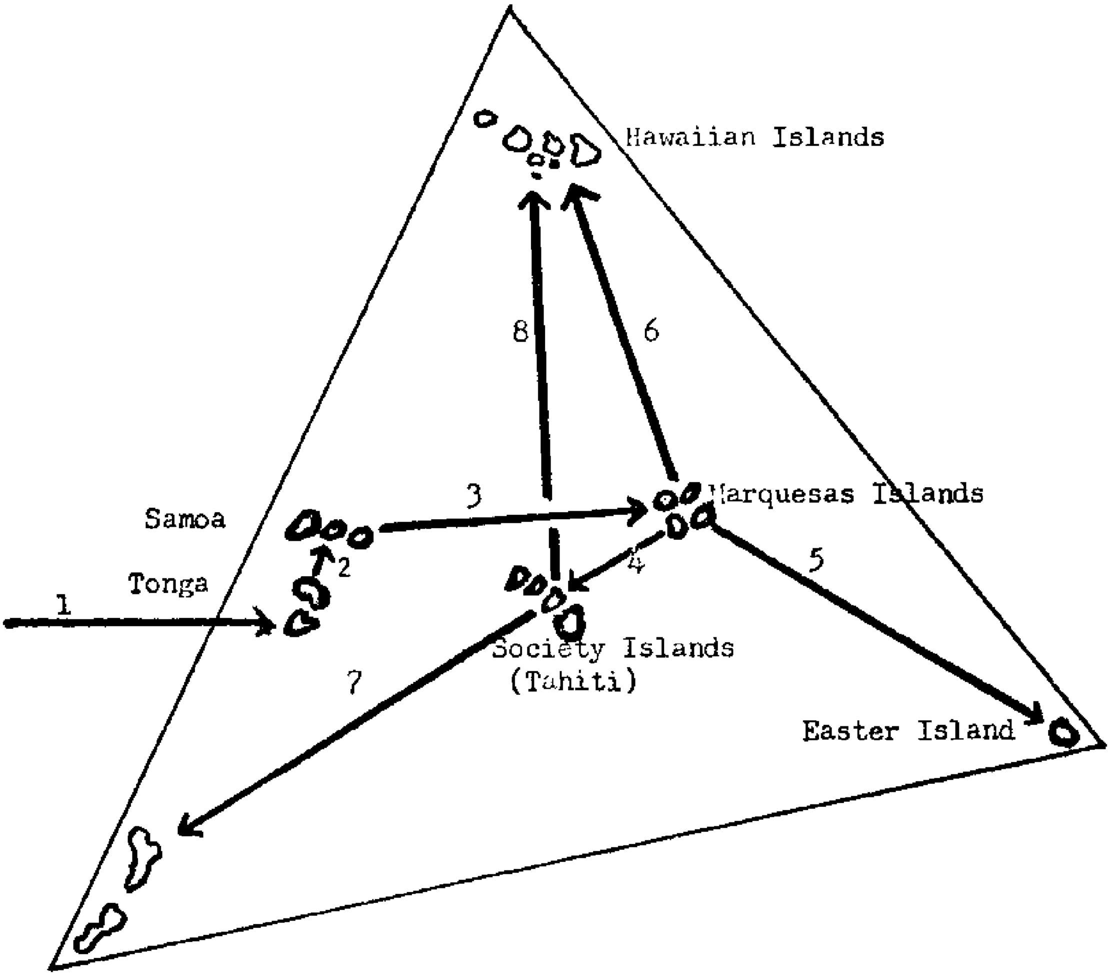
References:

Feher: Hawaii: a Pictorial History, Bishop Museum Press.

Kane, H.: Voyage, the Discovery of Hawaii, Island Heritage, 1976.

DOE: Map of Polynesia

Mitchell, Donald: Resource Units in Hawaiian Culture, Kamehameha School



Probable order of settlement and approximate dates:

1. Indo-Malay people arrived in Tonga about 1,500 B. C.
2. Some of the settlers migrated from Tonga to Samoa.
3. Some left Western Polynesia about 150 A. D. and reached the Marquesas Islands.
4. The Society Islands were settled from the Marquesas.
5. Marquesas Islanders settled on Easter Island (Rapa Nui).
6. Marquesas voyagers came to Hawaii, possibly 500 to 750 A. D.
7. Emigrants from Tahiti sailed to New Zealand and became the Maori.
8. Tahitians came to Hawaii, possibly 1,000 to 1,250 A. D.

Map adapted from Dr. Kenneth Emory's "Settlement Pattern" which was included in a paper delivered at the American Anthropological Association Annual Meeting, November, 1963 at San Francisco, California.

Dates taken from a paper "Origin of the Hawaiians" by Dr. Emory prepared in March, 1959 and brought up-to-date in 1964.

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Topic: Stars

Objectives:

The students will:

1. Learn to find the Big Dipper (Na Hiku).

2. Learn to find the North Star, Polaris (Hoku pa'a).

3. Learn to find Hawaii's zenith star, Arcturus (Hoku le'a).

4. Learn to find either Sirius (Hoku-ho'okele-wa'a) or Spica, zentih stars of Southern skies.

5. Learn that some stars correspond to the latitude of certain places on earth.

Materials:

Star chart handouts if available, reference material, overhead of Polaris, Big Dipper, Spica, Arcturus, black construction paper for optional activities.

Procedures:

1. One of the previous activities was to find the cardinal directions (N, S, E, W) at home. The student, then, should generally be able to find north. Ask them to observe the sky after sundown and report back the next day. Find out what they saw. Ask if anyone saw the Big Dipper (in the constellation Ursa Major, the Big Bear). Use the chart provided as a handout for the students and/or an overhead projection. Time of year is important. The best time of the year is April-July. Next best is September and February-March. In October-January, it is difficult to find the Dipper.

2. Once the students can find north and the Big Dipper, finding Polaris (Hoku pa'a) is easy. Two of the stars in the "cup" of the Dipper, Merak and Dubhe (pronounced "Dubby") are called pointers, since they seem to point at Polaris.

3. Have students locate Arcturus, Sirius/Spica. See background information.

4. Optional Activity:
   Use black construction paper or aluminum foil to make a planetarium. The constellation can be made by putting small holes for stars. The projector is a flashlight. This is not a perfect projection system, but the students can use it at short range (2 or 3 feet) to quiz each other on different constellations such as the signs of the Zodiac. It is possible to make a more elaborate display by the use of small lamps, called "grain of wheat" bulbs. LEDs (light emitting diodes) can be used, but don't come in white. A blacking material such as cardboard or masonite painted black with small holes drilled will work. Make your own sky!

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Background Information:

Arcturus is Hawaii's zenith star; that is, it appears to travel directly over the islands in an east/west direction. It is easiest to find by tracing a vague line or arc down the tail of the Big Dipper.

Spica, with a zenith at about 10 degrees South latitude, is a guide for finding the Marquesas and northern Samoa. It can best be seen from April to September. Spica can be found by continuing the arc Dipper's tail-Arcturus-Spica. It can also be found using the constellation Scorpius the Scorpion as a pointer.

Scorpius  * Spica

Sirius (Hoku-ho'okele wa'a), at about 17 degrees south latitude is the guide to Tahiti. It's name (it has many) means canoe-guiding star. It is best seen from late December through April. As a part of the constellation Canis Major, or Big Dog, it always follows its master, Orion the Hunter. Sirius is the brightest star in the sky, excluding the sun.

Because the earth is pointed almost directly at Polaris, all the stars seem to revolve around the North Star as the earth turns. The other stars appear to rise in the east and set in the west like the sun and moon. Because of the enormous distances involved, the stars seem to be in fixed positions, seeming to move only as the earth moves. The same stars appear in the same place in the sky at the same time each year. If the students look at a globe or map of the world they can trace across the lines of latitude from east to west. This is the same path followed by the stars, some in the Northern Hemisphere and some in the Southern. This makes star watching a little easier since we can predict where a star will be. Our zenith star Arcturus (Hoku le'a) follows a path at present of about 20 degrees North latitude, right over the island of Hawaii (in 1200 A.D. it was over Kauai at its zenith). For one of the more readable accounts, see H.A. Rey, The Stars, 1975 (author of Curious George), pages 110-123. The earth has north-south lines called lines of longitude. The meridian is the celestial equivalent. There is not enough time or space to go into detail. Longitude is explored very briefly in the unit on Polynesian Navigation.

Astronomy is an exciting topic to students but is difficult to teach since darkness is required. At home, there is always the likelihood of a streetlight or mountain blotting the view. In spite of this, the students can do a lot on their own once some basic directions have been given.

About 7,000 stars can be seen without a telescope. Of these, close to 200 were used as navigation aids by the travelling Polynesians. The students are not expected to learn these stars, but to appreciate the people that did know them and use them to find their way over very long distances without a compass or clock.

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By learning to find the star Arcturus (Hoku le'a), Spica, and Sirius (Hoku ho'okele wa'a), they will get a better idea of the hardships facing an open ocean voyager who must depend on memory and training, not on books.

Magnitude is the term used to denote the brightness of stars. Unfortunately, there is absolute magnitude (actual brightness) and visual magnitude (that which is seen). Different sources will give star brightness in one or the other (example: Arcturus (Hoku le'a) is the 6th brightest star, the 3rd brightest in the Northern Hemisphere in some sources such as Bryan, but the 4th brightest star, 1st in the Northern Hemisphere in other sources such as Kyselka).

STAR CHARTS are a great aid. The neat little lines connecting stars in the various constellations were unfortunately omitted in space; we must depend on imagination. TO USE THE CHARTS: NOTE THAT UNLIKE A TERRESTIAL MAP, WEST IS ON THE RIGHT AND EAST IS ON THE LEFT. This is because the map is to be used by HOLDING IT OVER YOUR HEAD. This will put west and east in the "proper" positions. Try it! Point the chart and yourself towards the north, hold it overhead so that east is to the RIGHT and west is LEFT. Perhaps an overhead transparency would help, or a mirror, to get the idea.

The planets are not included here since many teachers have their own units. The planets were also important to the Polynesians, especially for the planting calendar. The general references given include information about the planets.

Sirius, called Hoku ho'okele wa'a, A;a, Kaulua, Hiki kau lono meha, Lena and more, is the brightest star we can see. This is a beacon to Tahiti, which was used by the vessel Hokule'a and will be used again. The closest star besides the sun is Alpha Centauri, in the constellation Centaur. Alpha and Beta Centauri are pointers like Dubhe and Merak except they point to the Southern Cross which is visible from about April to July in Hawaii and parts of Key West, Florida.

Seasonal variation - While our day is neatly put into 24-hour blocks, the universe does not follow our lead. The revolution in space is about 23 hours, 56 minutes, nearly 4 minutes short of our time. This might not seem like much, but it means that the stars you see tonight will be seen in the same position 4 MINUTES EARLIER each night. In a month's time, this is 2 HOURS earlier. By the time twelve months roll around, the cycle starts over again. This is why the same stars are not visible at the same time each night. Sometimes they are there, but the sun is too, blotting them out of view.

References:

Bryan, E.H. Stars Over Hawaii Petroglyph Press, 1977.
Kyselka, W. North Star To Southern Cross University Press of Hawaii, 1978.
Johnson, R.K. Na Inoa Hoku Topgallent Pub. Co., 1975.
National Geographic Magazine The Heavens, insert in August 1970 issue.
Rey, H.A. The Stars, a New Way To See Them Houghton Mifflin, 1975.

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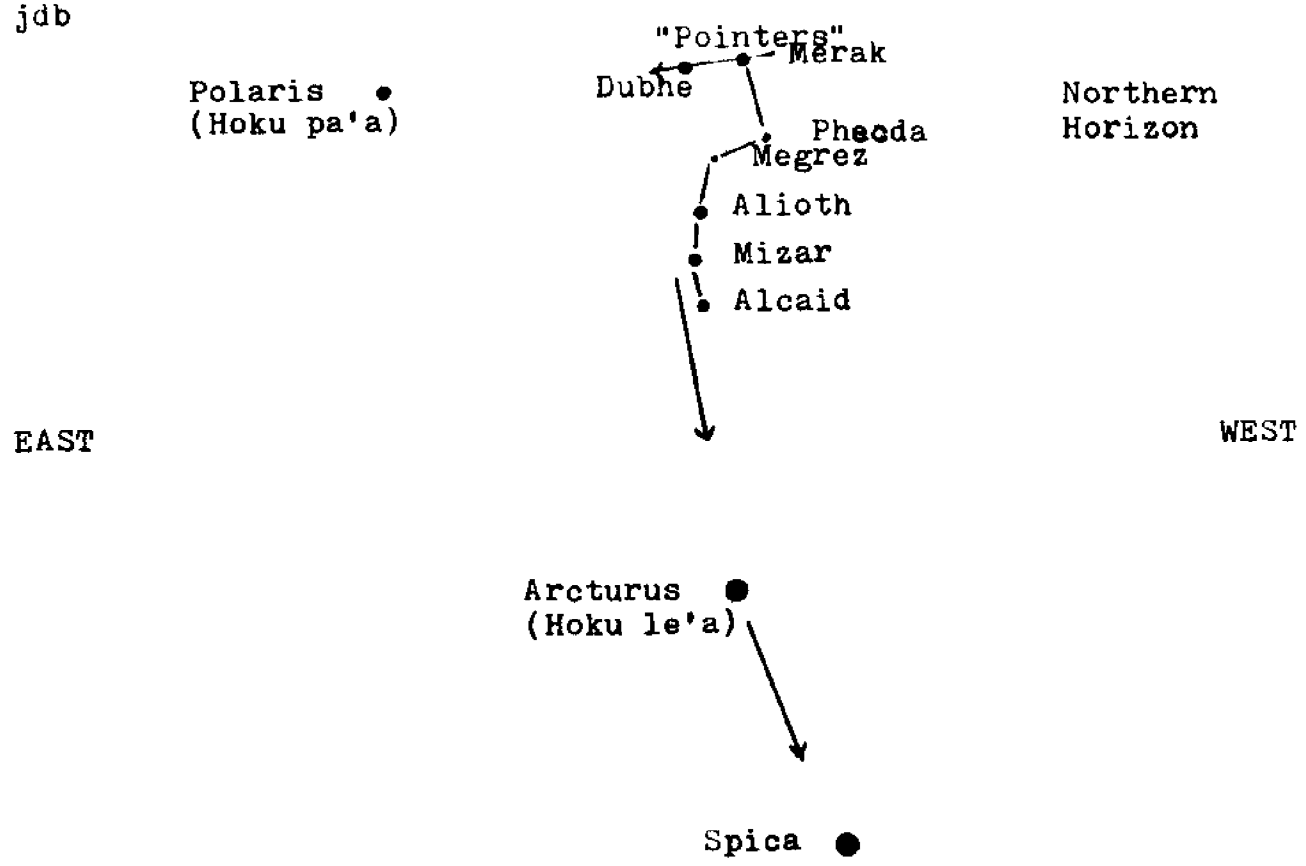

Chart 1. Sky in Early September, about 7 P.M.

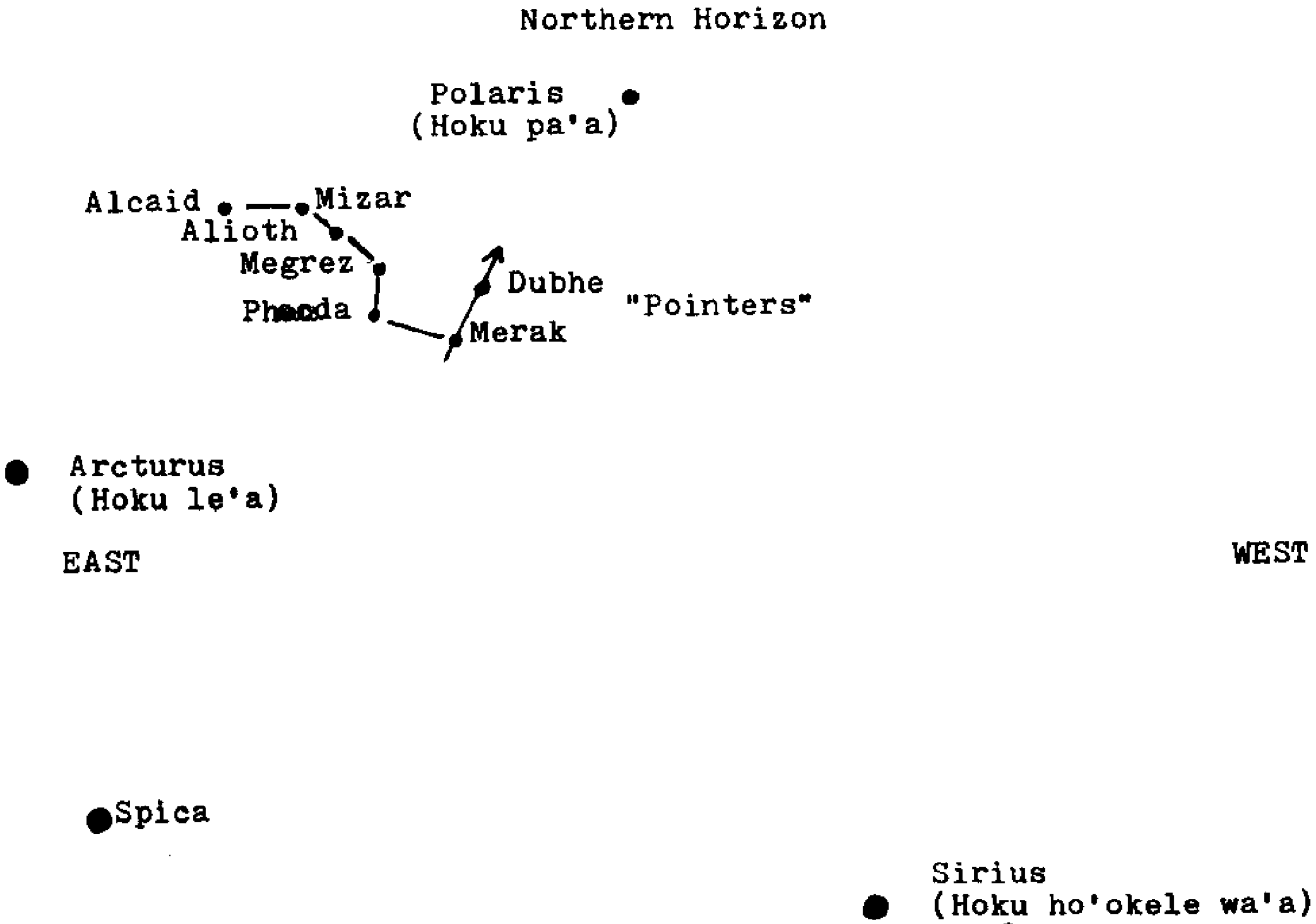

Chart 2. Sky in April, about 8P.M.

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Topic: Polynesian Canoes

Objectives:

The students will:

1. Learn that different Polynesian people had different types of canoes.

2. Learn the modern counterparts of most canoe features.

3. Learn three uses for canoes.

4. Learn some of the responsibilities of the crew.

5. Learn about balance by using a model to load.

Materials:

Styrofoam cups, stapler, pre-weighed masses (clay, wood, metal, whatever is available), student handouts on canoe parts, Polynesian canoe types (if available), loading diagram, paper such as oaktag.

Procedures:

1. Most students know what the Hokule'a looks like. Ask them what the canoes from other parts of Polynesia look like as well as how modern vessels like a catamaran look. Use the map insert from the December 1974 National Geographic Magazine or Canoes of Polynesia by Herb Kane. Note the different sail shapes and differences in the hulls. For those especially interested, construction techniques (single log hull vs. planked hull, for example) can be compared.

2. Use the D.O.E. handout on Polynesian Voyaging. This can be a game that is an exercise in oral language. Start by giving the Hawaiian word and its counterpart in English. Either ask for volunteers or call on individuals to respond with the correct part of the canoe (example "mast" -- kia). Increase the number of words to make it more difficult. The students should be able to recite a list of ten items after considerable practice. Example: "mast, boom, crossbeam" -- kia, paepae, 'iako. This can be from English to Hawaiian or Hawaiian to English. This same sort of language game should be practiced throughout the year with other units as well. The students should realize that the Hawaiians had no written language and depended on oral tradition for transmission of knowledge.

3. What can you do with a canoe? How were they used before Captain Cook arrived? The students should have some ideas. Besides migration, canoes were used for fishing, war, transportation, etc. The students should remember at least 3 of these.

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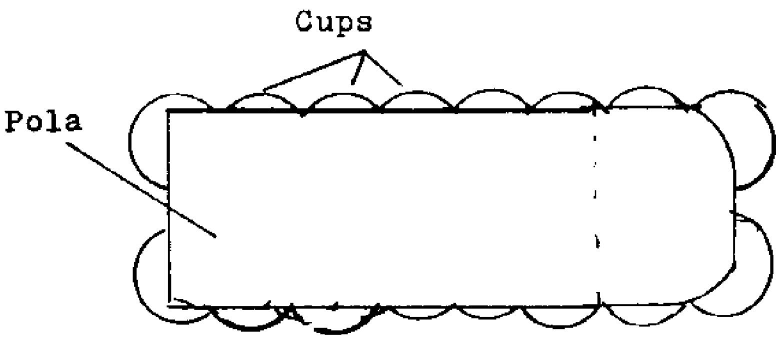
4. What did the crew do on board? What are the duties of a sailor? Who tells them what to do? How do they know which way to go? Most likely, the role of the crew is the same now as then. Bailing, lashing, raising and lowering sails, preparing food, rationing supplies, repairing, fishing, lookout duty, etc. would have been similar to the modern sailor's duties. There would be a captain or chief and, on long voyages, a most important person, the navigator. A kahuna of one calling or another would most likely be present.

5. What would happen if all the stores and provisions were loaded at one end of the canoe? While we can't use an actual canoe, we can try to balance our load using a model. Styrofoam cups should be stapled together in units of 4 to make the "canoes" :

88 These can be joined to make a canoe similar in proportion to the <u>Hokule'a</u> (15' X 60'):

88888888 Two cups approximate 15 feet. The cups can be placed in water upside down and a paper platform (pola) put on the upturned cups. The student task (can be in groups) is to load a given mass (500g, 1 lb., ½ lb. <u>etc</u>.) on the cups and maintain a proper balance. Waterproof masses should be used! A loading diagram is to be prepared, which is simply a picture of where the masses were placed on the hull:



6. Additional Activities

Poems:

Make up your own poem using words collected during this unit.

Write a poem about how it feels to see land after being at sea for five weeks, when your food is gone and you are very thirsty.

Write a poem about life on a canoe.

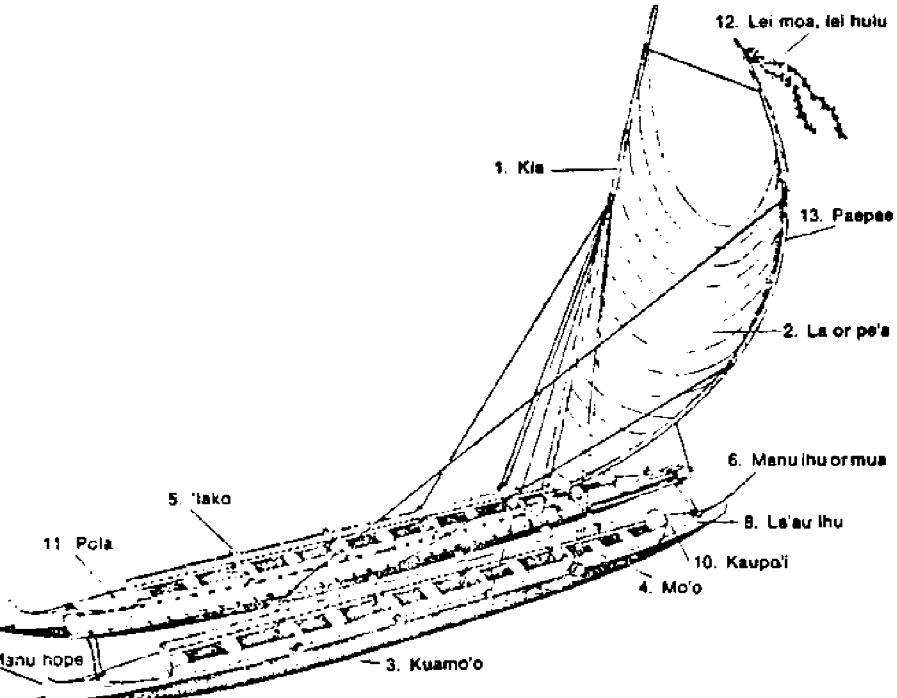
Art:

Draw some of the different Polynesian canoes.

Make a mural of some of the different types of canoes.

Literature:

Write your own legend. The topic could be "How the Hawaiians learned to make canoes" or "How the sail was discovered" or some similar topic.



Prepared by Nani Bowman Lyman
Illustrated by Herb Kawainui Kane

CANOE PARTS AND ACCESSORIES

1. Kia	(Mast)
2. La or pe'a	(sail)
3. Kuamo'o	(hull)
4. Mo'o	(gunwale)
5. 'iako	(crossbeam)
6. Manu ihu or mua	(bow ornamental elliptical end pieces)
7. Manu hope	(stern ornamental elliptical end piece)
8. La'au ihu	(bow piece)
9. La'au hope	(stern piece)
10. Kaupo'i	(median cover piece)
11. Pola	(platform)
12. Lei moa, lei hulu	(relative wind and speed indicator)
13. Paepae	(boom)

Items not shown, but may be part of canoe for long-distance travel.

Pa'u	(mat cover)
Hale lanalana	(house built on a double canoe)
Hoe uli	(steering paddle)
Hoe	(paddle)

From: Polynesian Voyaging
Office of Instructional Services/ General Education Branch
Department of Education, State of Hawaii
TAC 77-3223 April 1977

jdb

Topic: Life on the Canoe

Objectives:

The students will:

1. Learn that much preparation of the canoe, provisions, and especially the crew was necessary for a long voyage.
2. Learn that discipline and getting along with others were the most important qualifications for a crew member.
3. Learn about the harshness of living on the open ocean.
4. Learn two sources of water and two sources of food from the open ocean (survival techniques).

Materials:

The reference list can be used to read portions to students or to have them read on their own time.

Procedures:

1. In the past, as now, a group of people don't just run down to the ship and sail off for a month or two (here's a chance for current events, as the "boat people" apparently have been doing just that). The students have already made a list of "essentials" for a voyage (pre-test page). Now they should start to look at how these provisions are to be prepared and how to store them so that water, sun, other spoilage won't occur. How can fresh water be kept for a month when you don't have plastic jugs or metal cans? If you store water in a calabash or bamboo section, can you still drink it after a month? What about the crew? Is it possible to learn to eat and drink less so the food and water would last longer? Obviously, much preparation was and is necessary for a voyage of any duration: The canoe (or ship) must be tested for seaworthiness, any dried food takes time to properly dry and be wrapped, and especially the crew needed lessons in survival, self-restraint with regard to food and water, and in seamanship.

2. Show the students the approximate outline of a 15' x 60' rectangle (their canoe will be even smaller, 8' x 30'). Ask them if they, as a class, could live together inside that rectangle for 30 DAYS without getting out. (Some might not last 30 minutes at this stage!). How could the Polynesian voyagers last so long in cramped quarters? Did they practice or were they chosen because they had special qualities?

   According to Gordon Piianaia, Hokule'a crew member, there is a Hawaiian proverb that says, "a canoe is not swamped by the outside wave, but by the inside wave (known as the wave that swamps all.") (See D.O.E./TAC 77-3223 POLYNESIAN VOYAGING).

Ask the students for their interpretation of this saying. What are some individual qualifications that would be useful on a long voyage? What skills would you want your fellow crewmembers to have if you went on such a voyage? What sort of person should be in charge on the boat? ETC.

3. Here is a chance to read some actual experiences of life at sea. While reading entire books to the class is not practical, selected paragraphs or chapters will suffice to give "flavor". There are many to choose from. A few are:

   Gibbs, J., Shipwrecks in Paradise 1977
   Heyerdahl, T. Kon Tiki
   " Ra Expeditions
   " (National Geographic Special) Tigris
   Nordhoff & Hall Men Against the Sea (about the survival of Captain William Bligh and others set adrift from the H.M.S. Bounty)
   * Robertson, D. Survive the Savage Sea 1973
   uhen Minerva Reef
   Thompson, T Lost! 1975

4. Ask the students how one could obtain water out at sea (sea water will KILL since it dehydrates). Some might think of rain. If so, how can you catch rainwater? Can you hold a plastic jug up in the air to fill it up? What about in areas where there are rain squalls which can come and go in a minute or two? (The SAIL is a great rain catcher, ONCE THE SALT WASHES OFF!) Ask the students how many of them have eaten raw fish (probably many). Then ask if they have ever eaten raw fish without a sauce or salt added. Why do we add salt to raw fish? (it's not salty). A raw fish is a good source of fresh water and food. The flesh can be sucked on for liquid and the spinal fluid is nearly fresh water (vertebrae are snapped apart and sucked on). The liquid in the eye is also not salty (also not tasty!)

   How can you get food? (most will say fishing). Fishing can include luring to a hook (bait, feathers, etc.), spearing, grabbing, or gaffing (bring a hook on a pole upwards into the fish). As most sailors of tropical waters have found, if the gunwales of the boat are not too high, flying fish (malolo) frequently jump into the boat at night. Instant breakfast! Again in the tropics, sea turtles frequently come near a slow-moving vessel. These can be caught by hand, gaff, or rope to provide nourishment (fresh liquid from the raw flesh, too). The cast adrift sailor needs fishing equipment and a good knife! As a last resort to food shortage, plankton, the tiny plants and animals wandering in the sea, can be strained from the water and eaten. Crunch!

5. Other Activities:

   Art:
   Make a mural of the provisions needed for a voyage. The items can be drawn or cut out. Glue them in the proper place on a 3' x 8' paper canoe (strip of paper).

Make a series of drawings about the preparation of the canoe, provisions, and crew (could be a class project).

Draw a canoe on the open ocean. What are the people doing? (paint, sketch, sculpt o.k., too)

Literature/Language:

Use a canoe setting as the basis for a story about a group of people (not necessarily Hawaiian).

Write a poem or story about the thirstiest you have ever been.

Find five words that mean the same as thirsty or very dry (such as parched or dehydrated) and use them in a story or poem (it's alright to do "wet" words instead).

Music:

There must be some songs or sea chants about life at sea!

Poetry:

Samuel Coleridge wrote about the Doldrums: "Water, water everywhere but not a drop to drink" - what does this mean to a voyager? Other parts of the poem could be discussed as well. Rime of the Ancient Mariner.

6. Another Activity: Knobs

OBJECTIVES: The students will:

1. Learn to tie 3 different knots for the final boat day activities.

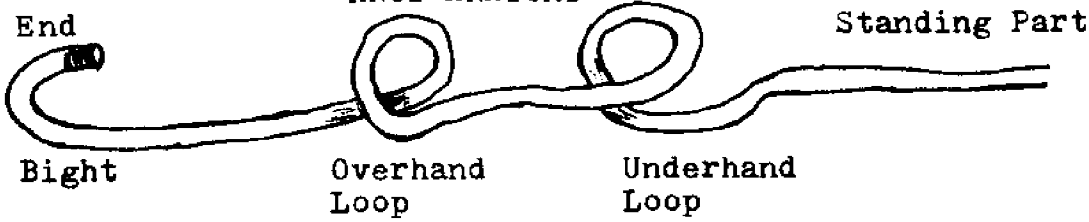
MATERIALS:

Rope, cord, or heavy string. Student handouts on knots.

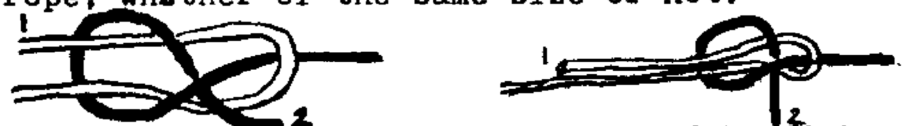
PROCEDURE:

1. Show the students the parts of a "knot". The knots to be learned are learned through practice. The students need some kind of cord for the practice.
Nylon parachute cord is a very good practice material since it can be obtained in bulk from State Surplus and it is easy to untie when finished. The parts of a knot:

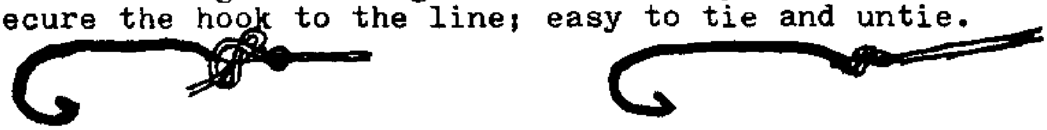
KNOT ANATOMY



Knot One: Sheet Bend- used for joining two pieces of rope, whether of the same size or not.

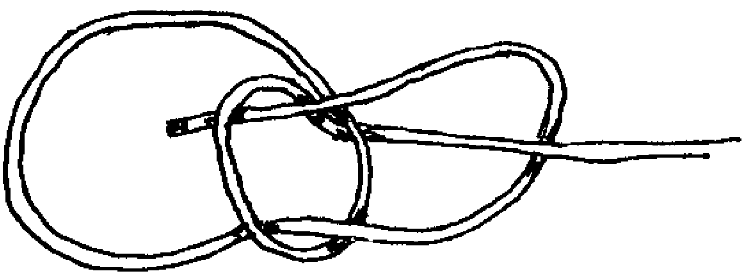


Knot Two: Figure-of Eight Knot- used by fishermen to secure the hook to the line; easy to tie and untie.



Knot Three: Reef or Square Knot- besides being useful for decorative projects in macrame, this knot is used in first aid because it lies flat. Can be used to join two cords together.

Knot Four: Bowline- there are many varieties of this knot, but this is the basic. The bowline is a life saving knot- it can be used to lift or lower an injured sailor. It's also used for hoisting and hauling. This is a knot that doesn't slip.



Background Information:

The references already mentioned are the best source of information. There are many accounts of life at sea, survival, etc. that cover the topics. To try to list all would make your task of information giver impossible.

Knots are as ancient as mankind. The basic knots presented here are not necessarily Polynesian, but there must have been some similar types used. If a sailor could learn at least twenty different knots, life was fairly easy. The four chosen here woul hardly get you past the dock, but are useful for some of the activities on the "boat day". The sheet bend and square knot are useful for joining two ropes or two ends together. The loop can be used for string games such as "cat's cradle". The figure-of-eight knot is a basic fishing knot. As with most knots, there are variations. The bowline is a very versatile knot which can get a person down a cliff as well as unload cargo from a vessel. Other knots could also be learned. For a macrame project, some half-hitches to go with the square knot would be useful. Consult a scout manual for help, or go to the knot bible, Ashley's Book of Knots. Another source that will give basics is Knotcraft. by A. & P. Macfarlan.

jdb

Ho'iana Ike Kai

Double-Hull Canoe Model

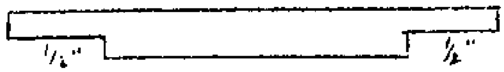
GENERAL NOTES

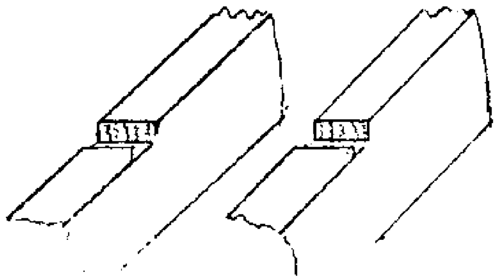
Basic hull is a piece of wood ½" wide, 3/4" deep, by 9" long. Variations can be made, especially with some of the canoes other than Hawaiian.

<u>HULL</u> (Kuamo'o):

Shape with a rasp, pocket knife, surform tools, X-Acto or other carving blades, or coarse sandpaper. Many students find that <u>pulling</u> the hull on the rasp or sandpaper is easier than holding the tool to the hull.

To hollow the hull, if desired, use standard carving tools, Speedball or X-Acto linoleum block cutters.

Construction is easier if the pieces to connect the hulls ('iako) are first shaped like this: 
Lashing or gluing will hold the hulls together. It also helps to make notches in the hulls to accept the cross-pieces ('iako). THIS TAKES MORE CARE SO THAT THEY ARE EVEN.

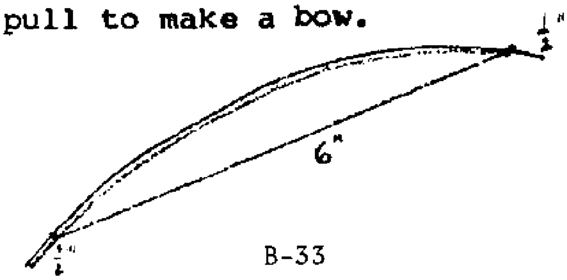


<u>MAST</u> (kia):

The hole for the mast is approximately 3/16". The chopstick is filed or sanded to fit. Use the LARGE end of the chopstick to make the bottom.

<u>BOOM</u> (paepae):

Soak a bamboo barbecue stick in water overnight. Tie a string on the blunt end , pull to make a bow.



For Some Students:

To make the model close to prototype dimensions:

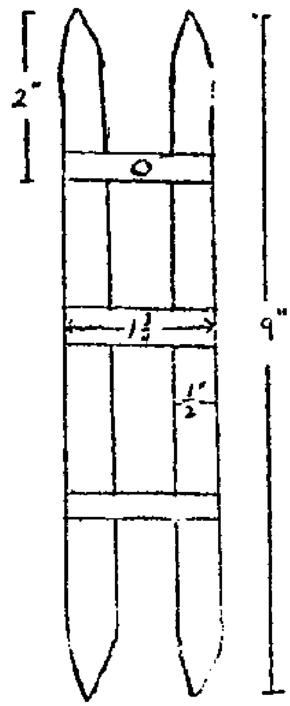
HULL: Approx. 1/2 X 3/4 X 9 " each.

Spacing approximately 1 3/4" between OUTSIDE edges of hulls.

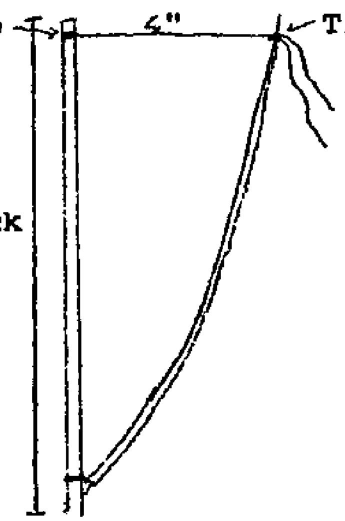
MAST: Approx. 5½" tall.

This canoe has considerable drag.

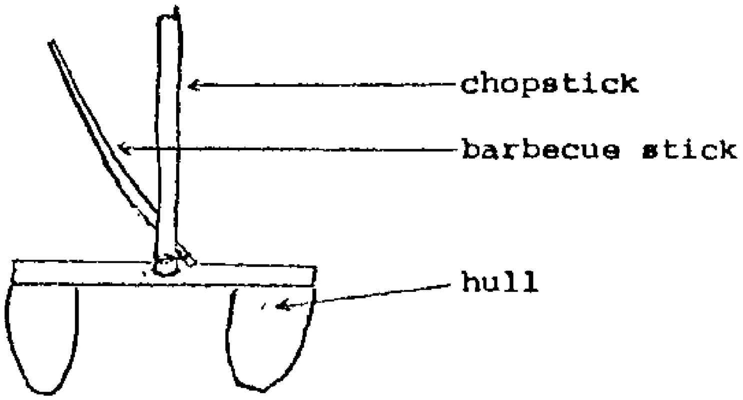
The sail area is very small. For added stability, 2½ " between hulls (outside) to support an 8" mast (1 chopstick length)is recommended.



To make a model with an adjustible boom:



Tie a knot on the chopstick, then on the boom.



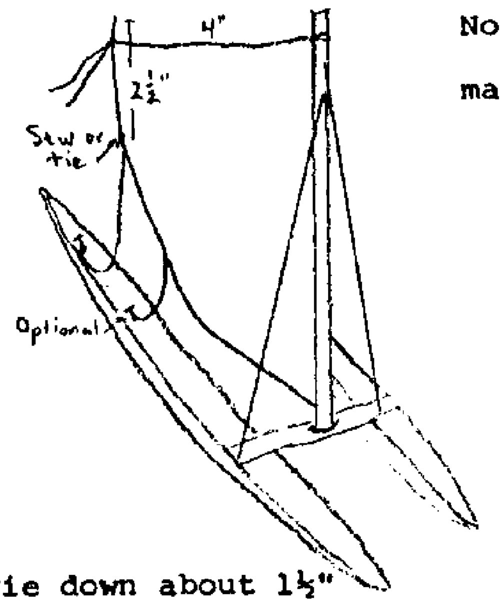
Note that the barbecu stick is BEHIND the Mast when looking from the front of the canoe.

Front of Vessel

SAIL (La or Pe'a)

Glue on the sail. Put glue on the edge of the mast and boom and lay on the sail material (cloth, plastic, lauhala, etc.). If possible, glue the sail to the FRONT surface of the mast. (This will give a few more mm. of surface area to the sail).

When dry, cut to fit the edges of the mast and boom. Sew or tie a 10" thread or string approx. 2½" from the top of the boom.



Note that the sail could be sewn onto the mast.

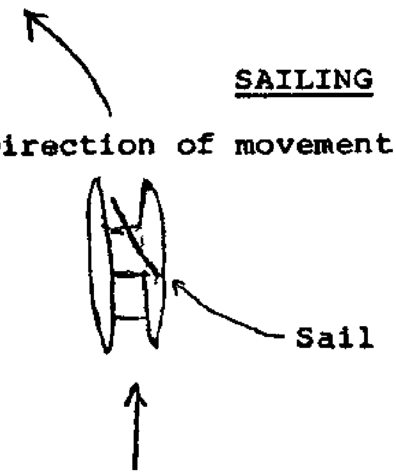
Strings or threads can be tied from approx. 2" from the top of the mast to each hull for greater stability.

Tie down about 1½" from stern of the starboard hull. Use a small nail, brad, pin, or thumbtack.

A second thread can be tied approx. 5½" from the top of the boom if more realism is desired. This is tied approx. 1" closer to the mast than the first.

SAILING

Direction of movement.



Wind Direction

In old Hawaiian days the tendency to turn to the wind was corrected by large steering paddles. They could be raised or lowered like the centerboard of many modern craft.

A physicians' tongue depresser might work the same way. A rubber band, pin, or thumbtack would hold it in place. An ice cream spoon () , might work. A popcicle stick might be too skinny. Try different positions. Start with the port hull. Typically the hulls were stained with the inner bark of the kukui tree (see Handy, *Native Planters in old Hawaii*, or Te Rangi Hiroa (Peter Buck) *Canoes*). If this is not available, a sealer such as Varathane could be used.

Points to remember: Elmer's or other white glue is NOT waterproof! Prolonged exposure to water will soften it. Don't leave boats in the water overnight!

Some canoes, such as the Samoan *Amatasi* need a curved mast as well as boom. Several days of soaking might be needed to soften the chopstick. Also consider notching the chopstick to help curve the final product.

J. Burke

Waianae Elem. School

jdb

Topic: Buoyancy

Objectives:

The students will:

1. Learn that there is an upward force that causes floating.

2. Learn that when the force down is greater than the force up, the object sinks.

3. Learn that no two objects can occupy the same space at the same time (discplacement).

4. Determine the volume of an object using the formula V = length X width X height.

Materials:

Sink or dishpans of water, clear plastic cups, various materials like modeling clay (oil-based), aluminum foil, rulers, styrofoam cup units from the canoe loading exercise, volumetric containers such as beakers, graduated cylinders, measuring cups, etc., an assortment of masses (can be pre-weighed masses of clay), student worksheets (make own or copy sample), permanent markers.

Procedures:

1. Ask the students what will float. Try to get a student definition of floating. When is an object floating as opposed to sinking? Are there any in-betweens? Using a clear plastic cup, mark the sides in centimeters from the bottom up. Have the students push the cup down into the water until the 1 centimeter mark is reached. Do you feel anything? Continue to the 2, 3, 4, etc. centimeter marks. Is it easier to push to 3 or 1? There is a force pushing up on the cup as you push down. The more force down, the more force up. This upward force of a fluid (water, air, sea water, alcohol, etc.) is called the BUOYANCY of the immersed object. As long as the force up is greater than the force down, the object will float. Can an object float only sometimes?

2. What happens if you keep pushing down? You are applying a greater force. What if you add water to the cup instead of pushing? As you add more water, what happens to the cup? When will it sink? Use the styrofoam cup units from the canoe loading activity. Try them right-side up and upside down. Compare the carrying capacity of the two. Also compare the mass held before sinking.
   Will 2 units support twice as much mass as 1 unit?
   Will 4 units support 4 times the mass of 1?
   What arrangements are more stable?

jdb

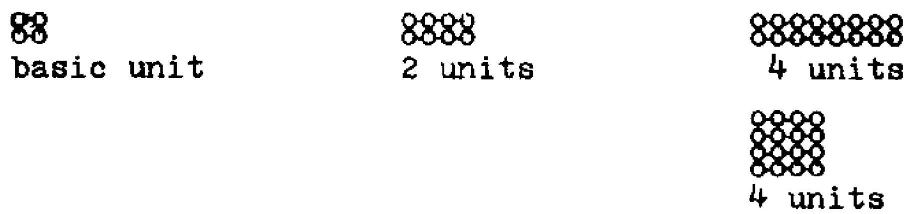
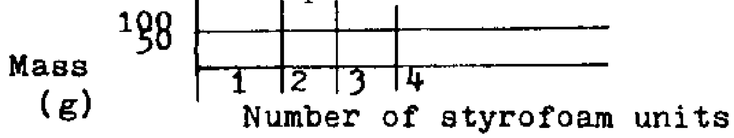


Table 1. Comparison of Masses to Sink Styrofoam Cups



As you add mass, you increase the force down. When this force downward exceeds the buoyant force upwards, the object sinks.

3. Use a clear measuring cup or graduated cylinder. Fill to a certain level with water (1 cup or 500 ml or some such). Use any object. Ask the students what will happen to the water level if the object is placed in the water. Most will say that it will rise. Why? There will likely be an intuitive understanding that the object displaces the liquid, but it is best to pursue this until students understand the idea that they both can't occupy the same space. (The dissolving of one substance in another, such as salt in water or alcohol in water may be confusing. Dissolving is not the same as displacement - i.e., 1 liter of water + 1 liter of alochol do not equal 2 liters of solution, but less).

4. This exercise is the most difficult and can be omitted. Ask the students how much "stuff" a cup will hold. Have them compare the volumes of various shaped containers. A set of equal volume, different shaped containers is useful. Make rectangular boats or barges of aluminum foil or modeling clay. Try to get them to make sides of a height that is easy to multiply, such as 1 centimeter. Introduce the formula for determining volume, Length X Width X Height = V. Do some sample calculations as a class. Try to encourage them to do their own.

Background Information:

Archimedes was the pioneer in fluid statics. He noticed that placing an object in water caused the water to be displaced, which is measurable. A 1 cm cube of brass placed in water will displace its own volume (1 cubic cm) of water. The volume of irregularly shaped objects can be determined by the amount of water displaced.

References:

Webster Division, McGraw Hill: Elementary Science Study (ESS)
Clay Boats What will float? How much will it hold?
Sink or Float? Prediction - will it sink or will it float?
Use common objects, predict and try.

Topic: Density

Objectives:

The students will:

1. Learn that an object that is denser than water tends to sink in water.

2. An object that has less density than water tends to float in water.

Materials:

Fresh water, salt water (several concentrations), droppers, containers, common objects such as sticks, foil, seeds, plastic, other classroom or brought-from-home objects; plastic spoon to retrieve sunken objects, student worksheet, optional food coloring, coarse salt, balance.

Procedures:

1. The idea is to try to show that fresh water floats on salt water. This will be explored in later years when the whole basis of Hawaii's water supply is a science topic. Some wood floats because a cubic centimeter of the wood has less mass ("weighs less") than a cubic centimeter of water. Ask the students which weighs more, 100 ml of fresh water or 100 ml of salt water. Most will pick the salt water as heavier. You can use a balance to verify this. Use food coloring to distinguish the two, preferably coloring the fresh water. Another procedure is to fill a vial or other container about one-third full of fresh water. Use the dropper to carefully put salt water into the vial (one of them has food coloring added.) What happens to the salt water? Does it sink or float?

2. Continue the sink or float activity, but this time try the same common objects in fresh and salt water. Clear plastic cups, ½ full of water can be used for teams of 2-4 students. Use the same objects as in the activity on buoyancy, but this time have different concentrations of salt water available. The students can compare the properties of fresh and salt water.

Name of	Fresh Water		Salt Water	
Object	Sink	Float	Sink	Float
1.				
2.				
3.				
4.				
5.				
etc.				

References:

Wesbster Divison, McGraw-Hill Elementary Science Study Colored Solutions uses various concentrations of colored salt water to explore density.
Sink or Float predictions on "floatability"
U. of Hawaii CRDG Hawaii Nature Study Program Reef and Shore

jdb Topic: Currents and Tides

Objectives:

The student will:

1. Learn that the tidal change is primarily due to the influence of the moon.

2. Learn that surface currents in the coean can be tracked and mapped.

Materials:

Globe and object to represent the moon or a solar system or earth/moon model. Map of area (shore) to be studied and small balloons filled with FRESH water.

Procedures:

1. Hawaii doesn't have the extreme tides like the Bay of Fundy or other such places. Here, a plus or minus two feet is remarkable. None the less, the pattern of the moon and our tides can be observed. If the moon is plotted, and there is an accessible beach, the tide at the same time of day can be recorded and the moon examined at the same time day or night to see if there is a pattern. Example: measure the tide at 10:00 a.m. daily while drawing the moon at 8:00 p.m. nightly, or whenever the moon is "available". As the moon goes through its phases, the tides should be affected.

2. Fresh water floats in salt water. A water balloon filled with fresh water and a tiny amount of air will float nicely. The movement of the balloon indicates the direction of the surface current. This movement can be plotted on the map of the area studied. Currents vary from large, open ocean, gross currents to small, local, wind generated currents.

References:

National Oceanic and Atmospheric Administration
National Ocean Survey, United States Coast Pilot No. 7
Pacific Coast ($6)
Same, Tide Tables, West Coast, North & South America.
($3.75).
Same, Tidal Current Tables, Pacific Coast of North America and Asia.
($3.75).

jdb

Navigation Units- General Reference

Currents and Tides

Dept. of Geography, Univ. of Hawaii, Atlas of Hawaii University Press, 1973.
Dillingham Tide Calendar, annual, Dillingham Corp.
Cablevision, Inc. Country Livin'monthly. Tide charts for the Waianae Coast.

Elementary Science Study (E.S.S.) Webster Div. Mc Graw-Hill.

Clay Boats
Colored Solutions
Daytime Astronomy
Light and Shadow
Making a Map
Mapping
Sink or Float?
Where Is the Moon?
Where Was the Moon?

Canoes

Buck,P.H. Arts and Crafts of Hawaii, Vol. VI, Canoes Bishop Museum, 1964.
Hornell,J. Canoes of Oceania Bishop Museum.
Kane, H.K. Canoes of Polynesia 1974.
National Geographic Magazine Discoverers of the Pacific December, 1974.

General Marine

Engel, & Ed. of Life The Sea, 1963.

Literature, Fact and Fiction

Bligh, W. A Voyage To the South Sea 1967.
Chase, O. Wreck of the Whaleship Essex 1965.
Dana Two Years Before the Mast 1963.
Defoe,D. Robinson Crusoe.
Graham, R.Dove.
Hall & Nordhoff Men Against the Sea.
Mutiny On the Bounty.
Pitcairn's Island .
Heyerdahl, T. KonTiki.
The Ra Expeditions 1971.
Kane, H.K. Voyage.
Lewis, D. We, the Navigators.
Melville, H. Bartleby, the Scrivener.
Billy Budd.
Moby Dick.
(These are sometimes available as filmstrips, or as Classics Comics).
Michener, J. Tales of the South Pacific.
Robertson, D. Survive the Savage Sea.
Ruhen Harpoon in My Hand.
Minerva Reef.
Stevenson, R.L. Treasure Island.

Don't forget Polynesian stories. Maui legends as well as those about other Polynesian heroes are a good introduction to the sea (Magic Banana , Rangiroa, etc.).

Navigation

Blackman, M. Hoku le'a 1976.
Bowditch, N. American Practical Navigator 1966.
Coggins, J. By Star and Compass 1967.

General Reference continued

Milligan, J.E. Celestial Navigation 1974.
Time/Life Navigation 1975.
Wright, F. Celestial Navigation, a Quick and Easy Way.

Polynesian Voyaging

Dept. of Education Polynesian Voyaging TAC 77-3223 April 1977.
Kane, H.K. Voyage, the Discovery of Hawaii 1976.
Mitchell, D. "Polynesian Settlement Pattern" in Resource Units in Hawaiian Culture, Unit 2 Kamehameha Schools.
National Geographic Magazine Discoverers of the Pacific December 1974.

Shipwrecks

Gibbs, J. Shipwrecks in Paradise 1977.
Robertson, D. Survive the Savage Sea 1973.
Thompson, T. Lost! 1975.

Sailing

Chapman Piloting, Seamanship, and Small Boat Handling 1974 .

Stars

Bryan, E. Stars Over Hawaii 1977.
Kyselka, W. North Star To Southern Cross 1976.
Johnson, R.K. Na Inoa Hoku 1975.
National Geographic Magazine The Heavens, insert in August 1970 issue.
Rey, H.A. The Stars, a New Way To See Them 1975.

Other

Poignant, R. Oceanic Mythology 1967.
Grey Polynesian Mythology 1965.
Coleridge, S. Rime of the Ancient Mariner.
National Oceanic and Atmospheric Administration, Nautical Chart Catalog 2 Pacific Coast Charts of Hawaiian waters available for $3.25 each (catalog free).
Sea Grant Marine Advisory Program Hawaii Coastal Zone News free from University of Hawaii.

jdb

Topic: Navigation

Objectives:

The students will:

1. Learn at least 4 ways the Polynesians knew an island was being approached as they sailed.

2. Learn about modern methods of navigation.

Materials:

Maps or globe showing wind and current pattern. Student handout, overhead of Polynesia would be useful. Compass, sextant, optional.

Procedures:

1. Ask the students about their knowledge of the Hoku le'a voyage. Ask how a sailor can find the right path while out of sight of land. Discuss the idea that there is a need to be able to determine present place and destination. By knowing where you are and where you are going, navigation can take place. The easiest is if you can see your destination. Line of sight is probably the way early people began traveling by water. Out of sight of land presents more difficulty. Ask the students how direction can be determined and followed out of sight of land.

   Finding an island that is not visible:
   Ask the students for ideas. What could you look for that would tell you that an island is being approached?

2. An Activity: "Junque Boat" II

Objectives:

The student will:

1. Remodel or make a new boat based on experience gained from the past boat building unit.

Procedures:

Same as Junque Boat I, but there is now more experience to pick and choose material as well as sailing technique. The students could possibly look at different Polynesian canoe designs (see References), or revise or build anew their old boats. Sail again!

References:

Kane, H. Canoes of Polynesia 1974
National Geographic Society Discoverers of the Pacific
National Geographic Magazine, December, 1974.

There are no stripes along the ocean to guide a ship the way highways do on land. Even if you can see the land, there is no guarantee that you are safe: what about reefs, rocks, swift tide currents, and wrecked ships? These might be completely invisible to the sailor so that there would be no warning as to their presence. Over many centuries, methods of finding where you are, and finding what to do when you get there, have been developed.

When mariners first went to sea, they would stay within sight of land as much as they could. By knowing certain landmarks, they knew where they were. That still didn't tell about sunken hazards, so written directions became common in Europe by the 1300's. (It's a good thing the Polynesians didn't stay within sight of land - there would have been no Polynesians!) To get an idea of position besides looking at places on land (what if it's dark or foggy?), DEPTH measurements were used. A line or rope with a lead weight could be lowered over the side to tell how deep it was as the ship progressed. In addition, a bit of grease or lard could be put on the weight to take a sample of the bottom sediments to aid in knowing position. One written set of sailing directions on how to get from Spain to England was like this: "Ye shall go north until ye sould in 72 fathoms in grey sand. Then go north until ye come into soundings of ooze, and then go your course east-north-east." The lines must have been very long; since a fathom is 6 feet, 72 of them would mean a lead line of more than 432 feet.

A map (called a chart when referring to the water) was the next most logical development. Aided by the compass, which would generally indicate north, the chart became of prime importance to a navigator.

Columbus, on his first voyage, used these methods to find where he was; he used a compass, a rough chart drawn on sheepskin, a sandglass that measured half-hours, and a speedometer that was someone to watch how fast you go for how long in time, you can tell how far you traveled. The compass then tells you in what direction. Unfortunately, there are many places to make an error. If the helmsman doesn't turn the "half hour glass" over instantly, the figuring will be off.

djb

English navigators came up with a better speedometer in the 1500's. They tied a piece of wood on a string, then put knots in the string at regular intervals. A "30 second glass" would be turned over as the wood hit the water. By counting how many knots in the string went through the navigator's fingers, during the 30 seconds, the speed was calculated. We still use knots as a measurement of a boat's speed.

Even with all that, unseen currents could move a boat many miles off course. Compass needles would tend to wander, causing more error. By the end of the 1700's, reliable clocks (chronometers) replaced sandglasses and variations in compass readings were worked out and put on charts.

One of the most famous contributors to these charts was an English sea captain named James Cook. He was a scientist and surveyor. His maps of the Pacific were so precise that they were still in use over 150 years after he drew them.

Now electronics have taken over much of the problems of navigation. Charts are still important in finding where you are or where you've been, but electronic aids take much of the work out of navigation. Columbus was able to place his ship's position within 350 miles. LORAN C, which uses radio signals, will place the ship within 1500 feet!

jdb

3. An Activity: Double Hull Canoe Model

Objectives:

The students will:

1. Construct a Polynesian-style double-hull canoe model.

2. Sail the model on a small pond or in calm waters at the beach.

Materials:

For each canoe: Hulls - 2 pc. ½" X 3/4" X 9" redwood lumber.
Mast (kia) - 1 chopstick (2 for masts).
Boom (paepae) - 1 bamboo barbecue stick for each.
Crosspieces ('iako) to hold hulls together - at least 3¼" X ¼" X 2½" sticks.
Sail (la) - piece of cloth or plastic.
Rigging - thread or string.
For the class: glue, urethane varnish, paint brushes and thinner, assorted tools (rasps, files, carving knives, Surform tools, etc.).

Procedures:

Similar to the "junque boat" but closer to an actual prototype. The construction can be done in class or the students can work at home and bring the finished product to school. Further construction hints follow from Ho'iana Ike Kai.

References:

Kane, H. Canoes of Polynesia 1974
Buck, P. Canoes: Arts and Crafts of Hawaii vol. VI 1964
Hornell, J. Canoes of Oceania Bishop Museum

Background Information:

Birds: Many birds have a limit to their range. If a certain bird is sighted that has a range of about 100 miles, then you know that land is within 100 miles of your present position.

Clouds: Typically clouds form over a high mass such as a mountain. Spotting clouds low on the horizon is a clue to a land mass.

Currents: Navigators could feel a difference in the flow of current and tell from this when changes in latitude occurred. As one crosses the equator, the pattern of currents changes, a clue to position.

Debris: Leaves, branches, or other land-based artifacts hint at the closeness of land.

djb

Stars: Certain stars indicate latitude. When the known star matched the latitude of the islands sought, the canoe was turned to sail parallel to its path. See the Tahiti-Hawaii and return sheet that follows.

Waves: Patterns of waves differ when land is nearby. The reflected wave patterns were "read" by the navigator to find the proper direction of travel. This can be demonstrated in a ripple tank. Generate waves from one end and watch the reflection off a rock placed in the tank.

Wind: The direction of the wind can give clues as to latitude. Subtle reflections from land can be detected by navigators.

The Polynesians could tell by various signs that they were near land. In addition, the navigator knew 150-200 different stars as part of his compass. These stars were useful for determining the latitude of the boat. The early sailors couldn't find the longitude, however. To find longitude, the east-west position, one needs a chronometer (clock). The Polynesians had no such instrument so it was necessary to find a way requiring no clock. Apparently they would sail deliberately east of Hawaii, as close-hauled as possible, almost into the trades. When the zenith star Hoku le'a was sighted, the canoe would turn west and follow a zig-zag pattern until signs of land were found. (See Polynesian Voyage Map). A similar plan was used for going back south again: the vessel would sail far to the east of the intended landfall, turn west, and zig-zag with the wind behind them.

References:

Blackman, M. Hokule'a 1976.

*Coggins, J. By Star and Compass 1967.

Bowditch, N. American Practical Navigator 1966.

Milligan, J.E. Celestial Navigation 1974.

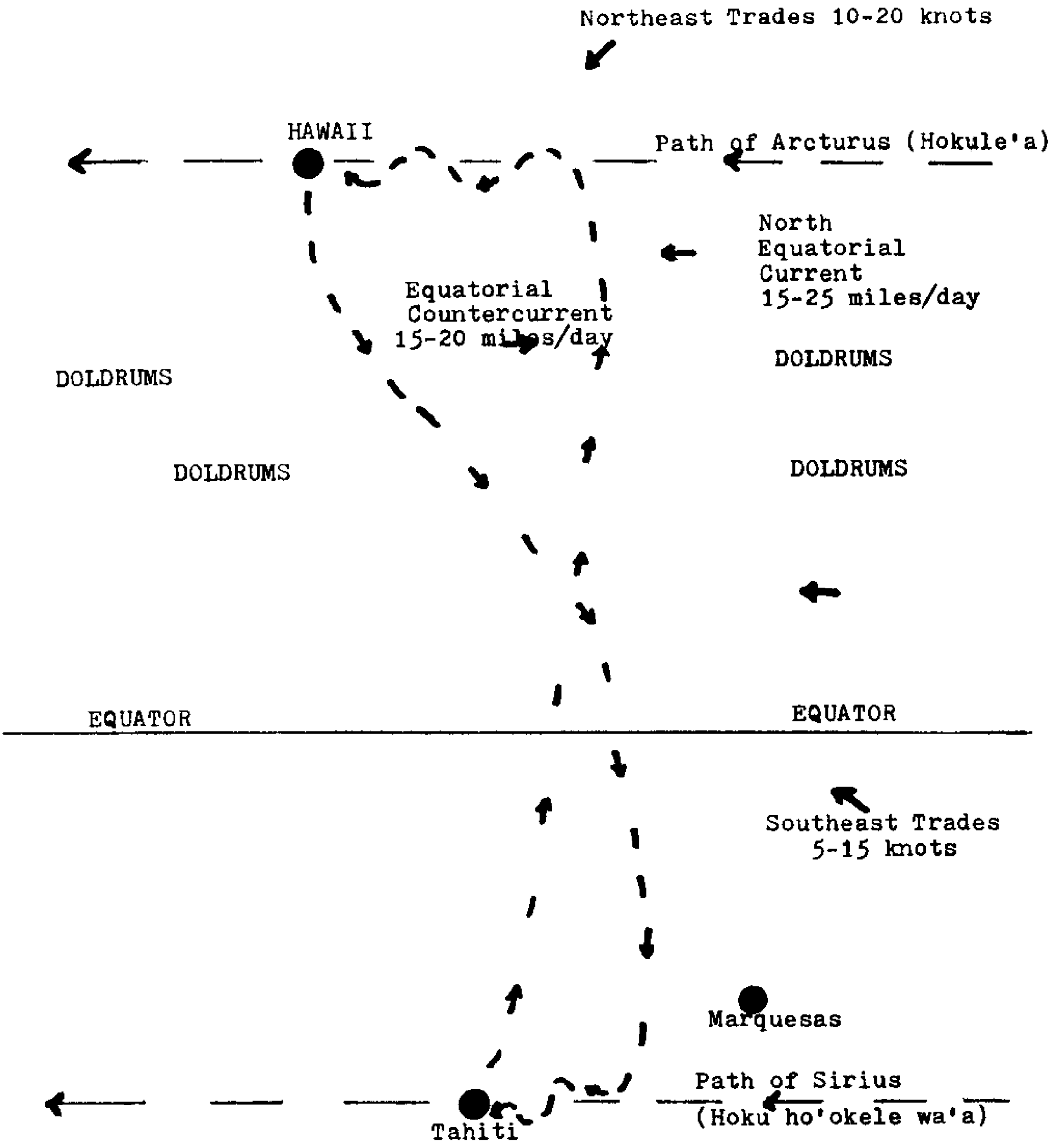
*National Geographic Magazine Discoverers of the Pacific December 1974 (also INSERT on Polynesian voyaging).

Lewis, D. We, the Navigators 1972.

*Time/Life Navigation 1975.

Wright, F. Celestial Navigation, a Quick and Easy Way 1969.

*Very useful



Polynesian Voyage Map

SECTION C

POLYNESIAN VOYAGING

TABLE OF CONTENTS

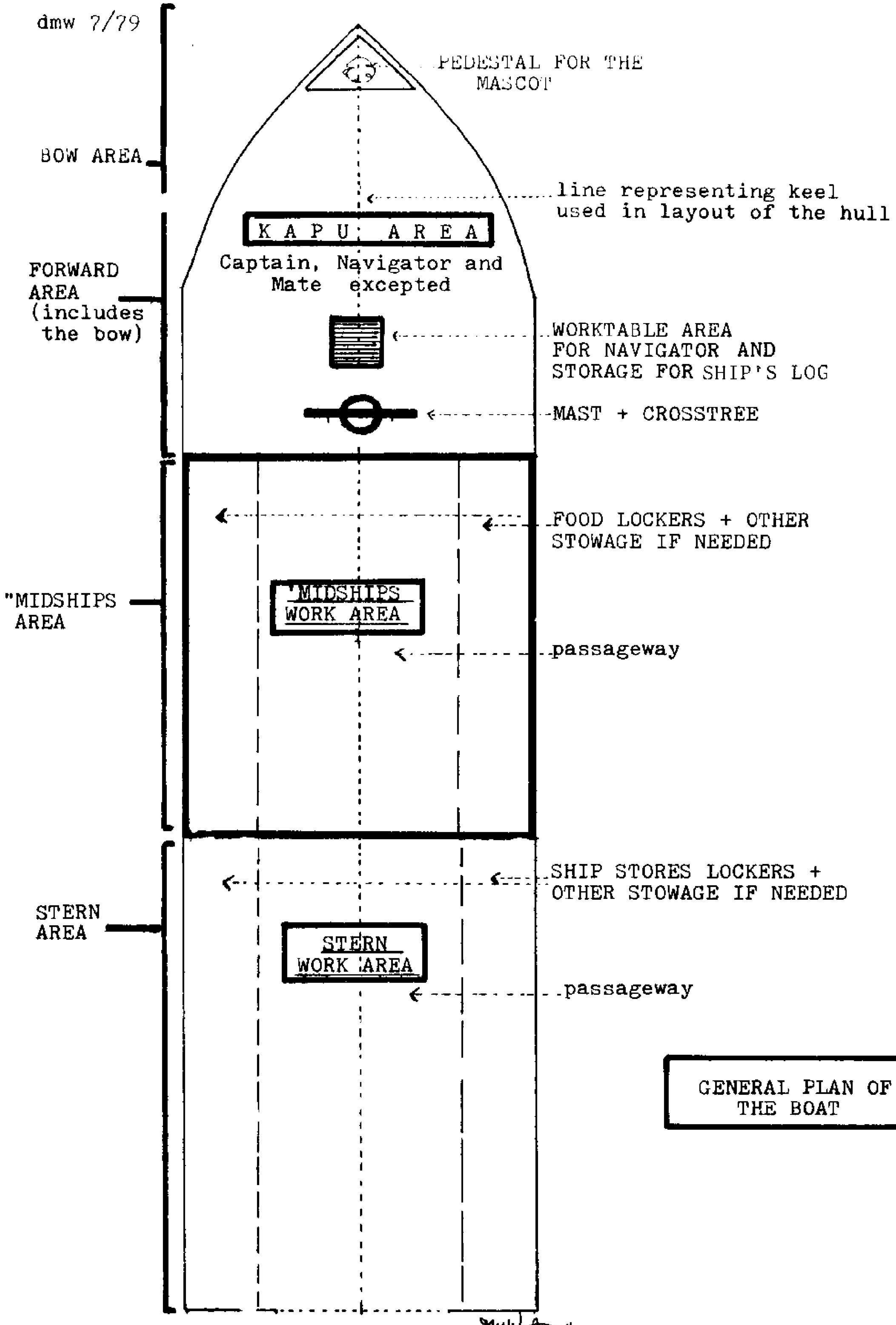
dmw 7/79

OBJECTIVES

1. Students should be able to demonstrate proper use (in this context) of knots.
2. Students should be able to translate diagrams and scale drawings.
3. Students should demonstrate ability to use and care for a hammer in a safe and proper manner.
4. Students should understand commonly used nautical words and use them properly.
5. Students should exhibit in their behavior aboard 'ship' that they have knowledge of some of the elementary rules of conduct that are customary.
6. Students should be able to explain reasons for nautical customs they use.

PART 1. PREFABRICATION OF SHIP COMPONENTS

dmw 7/79



GENERAL PLAN OF THE BOAT

dmw 7/79

CHECKLIST OF MATERIALS NEEDED

1	inner tube (car size) cut in strips
23	stakes (20-24"long, 3/4-1"diameter)
10	plastic tent pegs
22	copy machine paper cores
1	36" wooden dowel, 5/8- 3/4" diameter
1	small plastic ring from center of roll of mending tape
2	40 ft lengths of light line for railing
1	16 ft length of heavy string for halyard
2	24 ft lengths light weight line for stabilizers port and starboard
2	36ft lengths light weight lines for fore and aft stabilizer lines
6	6ft poles (table top frame) for Hale
6	3ft poles (table top frame) for Hale
12	30" stout poles (table legs)
1	5 ft very light line for lei moa
132	22" lengths of line (82 yds) (panel lashings) (9-ply butcher twine is fine)
X	cardboard boxes of same size (not over 14"wide) for food locker and ship stores lockers
1	sturdy table height box (Navigators 'table')
1	triangular shape stand for mascot
1	mascot figurine
32	24" x 16" cardboard panels (siding panels)
1	appropriately decorated LOGBOOK

paints, miscellaneous colors (siding decoration)
waterproofing for siding and mascot, LOGBOOK cover
miscellaneous materials for Lei Moa

X	hammers
1	FIRST AID KIT (onboard)and
X	dilute Elmers glue (if making dowels out of paper)
X	enthusiasm, FUN

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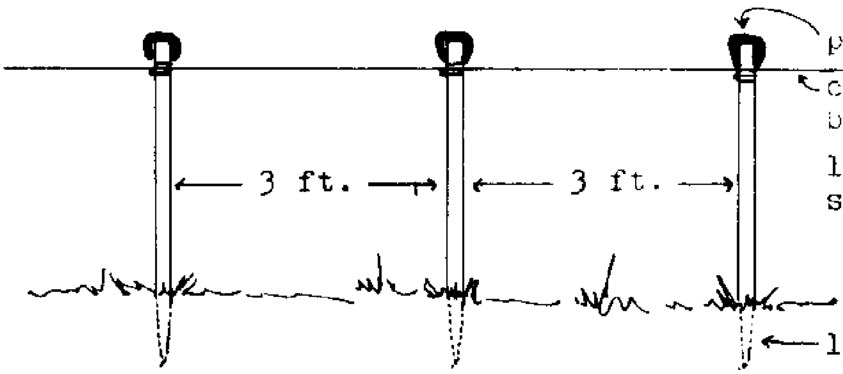
draft

CONSTRUCTION OF SHIPS' RAILINGS (SIDINGS)

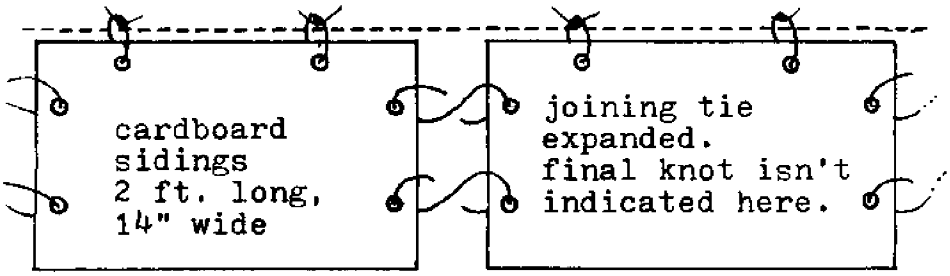


protective cap on stake

continuous line running from bow to stern.

line firmly knotted to each stake

long pointed end (4"



stake line from bow to stern

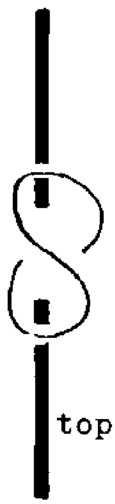
final knot is a simple bow tie

when tied, space between panels is about 1½ inches

eyelets 1" from edges

panels are joined in two long sections, one for each side of the ship (from bow to final stake on stern of ship)

each long section is properly placed inside the line of stakes and then tied to the stake line



vertical view of two panels showing the S shape of the joining line. A bow tie over the connecting line completes the joining knot

top of panel

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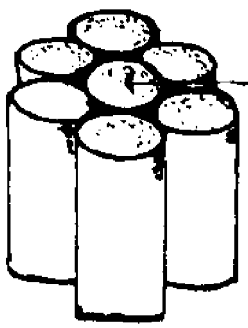
MAST CONSTRUCTION



Base assembly

<u>THE BASE:</u> consists of 6 copy machine cores placed around a the base of the mast.

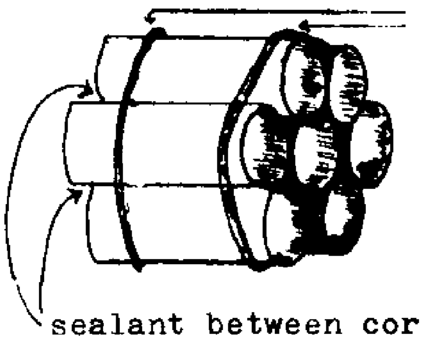
(a) assemble 6 cores around the central 7th core that represents the mast.

(b) Using strong string or large strong rubber bands, tie the bundle together tightly as illustrated.

(c) turn the base assembly on its side And pour a sufficient amount of good sealant between each of the cores to seal them together.

(d) Allow sufficient time for sealant to dry, then bind the entire unit with wide masking tape.

(e) Remove the central core.



<u>THE MAST:</u> consists of 3 or 4 fabricated sections made of copy machine cores. The top section has a dowel (the crosstree) through one of the cores.

The three sections, when completed, are joined to form the mast.

4 cores make an easy-to-handle length although more can be used.

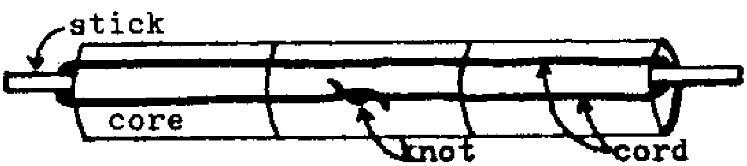
(a) glue cores together, end to end.

(b) insert two strong sticks into the long tub and tie each one tightly, with a cord. Leave these in place until glue is thoroughly dried. Sticks are are opposite each other for even stressing of the tube.

(c) remove sticks and cords. Make as many tubes as needed in the same manner

8 cores = 5 ft.

<u>Pre-stressing a section</u>



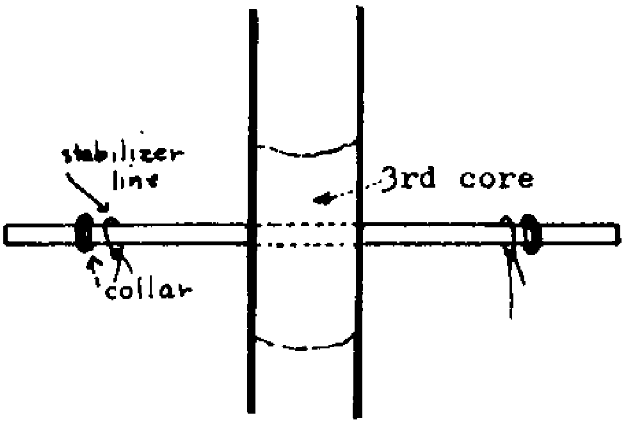
A 3-core tube, showing position **of one stick**.. Knotting the cord is probably easier at one end. Main point is maximum tension in the cords. Be sure tension is the same in both cords

<u>TOTAL HEIGHTH OF MAST SHOULD BE</u>

<u>8-9 feet</u>

Top section of the unassembled mast is slightly different from other sections, because of the crosstrees.

The crosstree is a piece of sturdy (1/2 to 3/4" diameter) dowling 3 ft. long.

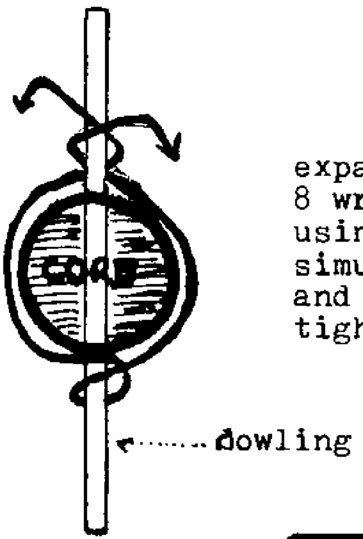


(a) bore a hole large enough to admit the dowling through middle of the third core from the top.

Be sure the holes are in line, and parallel to the ends of the core.

(b) insert dowling until the length of the exposed dowling is the same on each side of the core.

(c) if the holes are rather large, the dowling may be secured by using a figure 8 wrapping technique, as illustrated.



expanded figure 8 wrapping, using both ends simultaneously and pulling tight.

(d) 4" from each end of the crosstree is the anchor spot for the port and starboard stabilizer lines.

to prevent the lines from slipping fashion a "collar" around the dowling by wrapping twine around the dowling to form a strong ridge, or stapling piece of inner tube or other heavy material there.

FINAL ASSEMBLY OF SECTIONS PRIOR TO STEPPING THE MAST

Each of the sections should be glued together shortly before BOATDAY. Best policy is to glue two sections together and prestressing as was done with the individual cores.

When the larger sections are then glued together to form the entire mast IF AT ALL POSSIBLE :

prestress the entire assembly, with sticks and lines, or at least with two lines.

Be very sure the sections are perfectly in line

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FRAMEWORK FOR THE HALE

The plaited palm frond sections that comprize the 'roof' of the Hale will cover the mid section of the ship : 8 ft wide and 9 ft long. The supports for the roofing can be made in several ways, depending on time, materials, and spirit of adventure.

CARPENTRY METHOD

requires 1x4 lumber for the frame and table legs or lumber to make them

requires considerable hammering, (possibly sawing)

safety precautions VERY necessary

a number of tools are needed

DESPERATE METHOD

This calls for three standard 3x6 classroom tables although two will do if things are REALLY BAD!!!!!

Simply transfer to the boat and cover with the woven palm frons.

No learning and no Brownie Points for this. It's just answering the last call for HELP!!!

LASHING METHOD

- more representative of old Hawaii
- illustrates use of 'foundmaterials' and art of 'make-do'
- safety considerations are minimal
- promotes new skills of knotting and lashing
- cost: virtually nil

Construction: suggest three 3x6ft frames (tables without tops).

materials : possibilities

mop, broom handles
haole koa sticks
bamboo poles
window shade poles
left over lumber strips
copy cores for legs
tightly rolled newspapers
yardsticks
yardage tubing strengthened by wrapping with newspaper soaked in thin glue (some fabrics are always rolled on tubes, not on the flat cardboards)

heavy string, light line for lashing

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THE LEI MOA ASSEMBLY

1. CONSTRUCTION OF THE LEI MOA

The leimoa is simply a light weight piece of string or fishline that has very light weight, brightly colored materials attached to it at regular intervals.

The originals used feathers from the Moa bird, but our modern day counterpart can use fabric, feathers, fine strips of ribbon such as used on Christmas packages, or pieces of old rubber balloons. Kite materials might do.

Colored materials should be attached in such a way they will not slide on the line.

Line should be 5-6ft long.

2. ATTACHMENT OF LEI MOA TO THE MAST

(a) Most simple way is to tie the Lei Moa to a 3-4 ft light weight stick or pole (yardstick works fine)

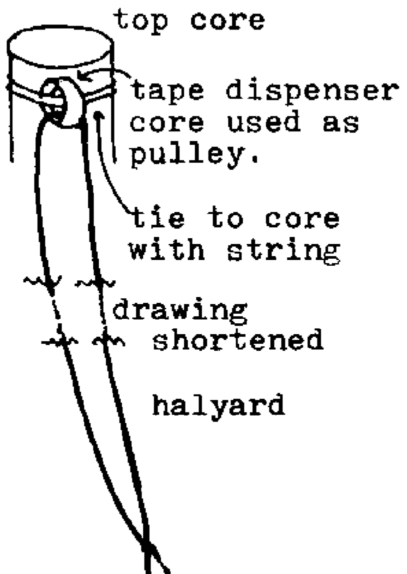
The pole is then securely taped, and then tied, to the top core of the mast when it is assembled prior to the boat construction.

NOTE: Using this method does have its drawbacks:

1. It will eliminate an important shipboard ceremony associated with the christening of the ship
2. In the event you have very strong winds on boatday, there is a possibility the tie and tape might not be sufficient to keep the pole in place, and the added strain on the mast might create problems.

(b) The most professional way is to devise a simple halyard. (a small pulley and a long loop of line)

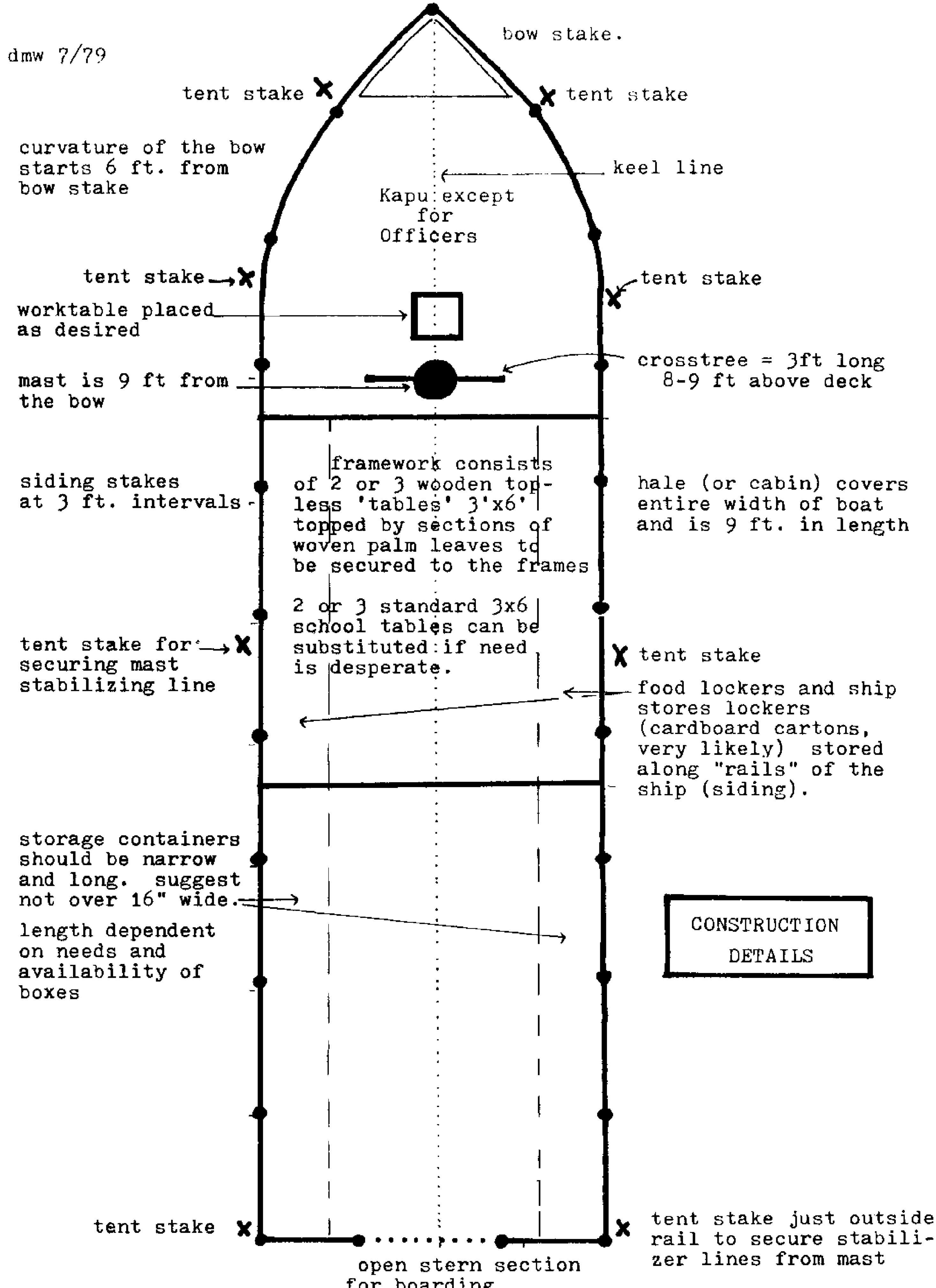
NOTE: the Lei Moa is NOT attached to any pole in this case. There should be a piece of string at the end to tie it to the halyard.



The Lei Moa is attached to the halyard when the ship is christened, and is raised to the top of the mast in exactly the same fashion as the school flag. It is lowered just before the ship is unloaded.

16 ft of line are threaded thru the pulley, ends are tied together to form a continuous loop. With the Lei at the top, the line is secured around the mast.

PART 2: CONSTRUCTION OF THE SHIP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bow stake.
tent stake
tent stake
curvature of the bow starts 6 ft. from bow stake
keel line
Kapu except for Officers
tent stake
tent stake
worktable placed as desired
crosstree = 3ft long 8-9 ft above deck
mast is 9 ft from the bow
framework consists of 2 or 3 wooden top-less 'tables' 3'x6' topped by sections of woven palm leaves to be secured to the frames
siding stakes at 3 ft. intervals
hale (or cabin) covers entire width of boat and is 9 ft. in length
2 or 3 standard 3x6 school tables can be substituted if need is desperate.
tent stake for securing mast stabilizing line
tent stake
food lockers and ship stores lockers (cardboard cartons, very likely) stored along "rails" of the ship (siding).
storage containers should be narrow and long. suggest not over 16" wide.
length dependent on needs and availability of boxes
CONSTRUCTION DETAILS
tent stake
tent stake just outside rail to secure stabilizer lines from mast
open stern section for boarding

LAYOUT OF DECK PLAN
(prior to construction)

Materials needed: ..measuring tapes or rules
..means of marking outline on grass
..1 piece of heavy string or line 30 ft long
..1 piece of string 8 ft long with knot at 4 ft.

Proceedure:

(a) select area. not too close to buildings or other ship positions.

determine direction of ship

(b) use 30ft. line to indicate keel of the ship. anchor firmly. (temporary)

(c) at the stern, draw 4 ft line on each side of the keel line that is perpendicular to to the keel.

(d) drawing outline of stern and 'midship section

use 3 students holding the 8ft line. Middle student holds center knot and holds it over the keel line. Ends of line are held by the students who measure the sides and mark it at 3 ft intervals. to indicate stake positions

CAUTION: BE SURE THE LINE IS ALWAYS PERPENDICULAR TO THE KEEL.

carry these markings forward for 21-22ft. This completes outline of the stern and 'midships section of the ship.

(3) drawing outline of the forward section of the ship.

(1) easiest way is to start at the bow. Use the 8ft piece of string to layout a nicely curved bow section on one side of the keel and then copy it for the other side..

(This was done 'for real' in the old days!)

indicate stake positions on these lines. (3 ft intervals are ideal, but need not be absolutely accurate)

(4) Once the outline of the ship is made and all positions for the railing stakes are clearly indicated..

(1) mark mast location 9 ft from bow

(2) indicate where the tent stakes should be

(3) draw a line across the ship 10 ft in back of the mast to indicate stern end of the HALE.

(4) mark position of Navigators table

remove the line used to indicated position of the keel.

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BOATDAY !

1. STAKING THE RAILING (SIDING) OF THE SHIP

Preliminary work:

.. It is assumed the outline of the ship is complete

.. It is VERY IMPORTANT that holes for the stakes have been made prior to BOATDAY. If this has not been done, there will be a serious delay.

.. stakes have been properly prepared and divided into two bundles

.. tent pegs have been divided into 2 bundles

Materials needed..

.. 46 prepared stakes, in 2 sets
.. 8 tent pegs, in 2 sets
.. 4 or more hammers, one per team

.. 3 students per team: hammerman, stake holder and verticality observer (1 person can peg)
.. suggest two teams per side, starting at bow and stern. (race??)

STAKING PRESENTS SAFETY HAZARDS.

Proceedure:

.. suggest students concentrate on many blows of less than maximum strangth rather than a few heavy blows that might misfire and cause accidents.

.. tent pegs should be placed AFTER staking crews are out of the way

.. pegs are slanted so the top points away from the ship side, and the tying hook on the peg is pointing downwards, not up.

PROPER CARE OF TOOLS AS IMPORTANT AS PROPER USE

2. ATTACHMENT OF RAILING LINE

Materials needed:

.. two 40 ft light weight lines, one for each side, small loop at first end

.. 2 teams of 2 students each, one for each side one student hold coiled line and checks on line tension, while the other ties line to each stake, from bow to final stake on the stern that marks the BOARDING AREA.

Proceedure:

.. Put loop over bow stake
.. properly attach line to each subsequent stake
.. securely tie off at last stake
.. coil any remaning line and hang coil on the stake

3. ATTACHMENT OF SHIP SIDING PANELS TO TO THE RAILING LINE

Preliminary work:

.. Panels have been decorated and perforated according to instructions
.. two sets of 16 panels each have been tied together according to instructions a
.. each set of panels have been accordion- folded to form a stack that is easy to handle
.. 22" ties have been put through each of the perforations at the top of each siding panel,

Materials needed:

.. 6-8 students for each side.

Proceedure:

.. each stack of panels is placed at the bow with the ties at the top, and placed inside the stakes. DECORATED SIDE FACES OUTSIDE

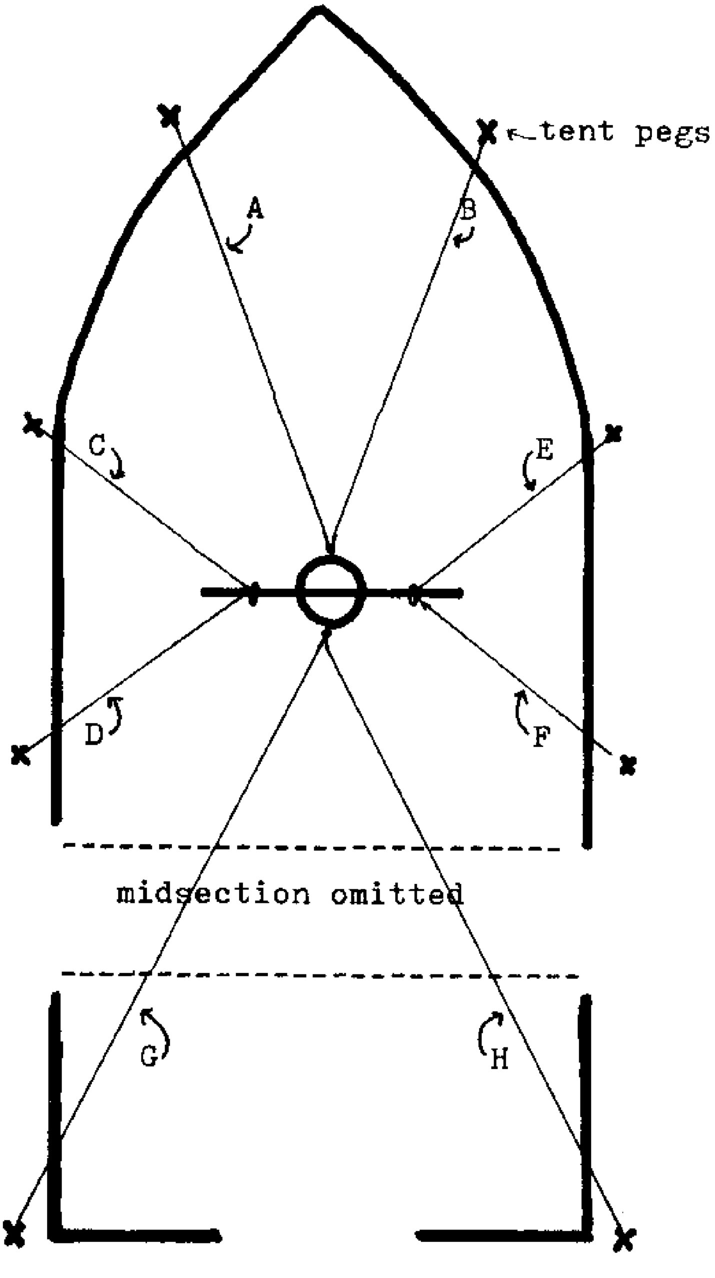
.. the bottom panel is tied to the bow stake to secure the siding, and the entire length of panels is unfolded and leaned against the stakes.

.. If the section is a little short of terminating at the boarding area stak, simply loosen some of the lashings that hold the panels together.

.. secure the panels to the railing line by the ties on each panel.

PANELS DO NOT HAVE TO MATCH SPACES BETWEEN THE STAKES. Panels themselves however, should be evenly spaced

PLACEMENT OF
STABILIZING LINES



A and B = Forward lines

C and D = port side lines

E and F = starboard side lines

G and H = Stern lines

Bow and Stern lines are attached to the mast just above the crosstree

Port and Starboard lines are attached to the crosstree about 6" from each end

Each 'set' of lines may be either one long line doubled at the point of attachment to mast or cross tree, or two shorter lines tied together.

4. STEPPING THE MAST AND SECURING THE STABILIZERS

Preliminary:

.. the base collar for the mast has been prepared

.. all sections of the mast have been assembled

.. all 4 sets of stabilizers have been attached properly, with ends temporarily secured so lines will not interfere with placement of the mast.

.. the halyard system (pulley and continuous line) has been attached.

.. stakes for securing stabilizer lines have been properly placed.

Materials needed...

base collar
.. 2 tent pegs to secure base collar
.. hammer for pegging
.. assembled mast

3 students to carry and hold mast in place
1 student to place collar, and set 2 pegs inside
8 students.. One for each stabilizer line, to secure same
2 observers to check on vertical position of the mast

Proceedure:

.. set collar in place
.. mark place for 2 pegs, fore and aft the mast
.. set pegs firmly then replace collar.
.. carefully set mast in the center of the collar
.. hold in place while stabilizer lines are handed to students
.. students move into position by the proper peg
.. students on port and starboard sides attach their lines to pegs
.. check is made for vertical position and readjustments made if necessary
.. fore and aft students secure their lines in the same manner, checking and readjusting as needed.

5. SETTING NAVIGATORS WORKTABLE AND PEDESTAL FOR SHIPS MASCOT IN PLACE.

Preliminary:

.. pedestal has been made and has provisions for making mascot figure secure.
.. sturdy "table" has been built

Proceedure:

.. have students bring on board and put them in designated place

APPENDICES

SUGGESTED ACTIVITY
FOR
CHRISTENING THE SHIP + GETTING UNDERWAY

After all materials for the voyage have been brought aboard students assemble at the stern of the ship, facing the mast. Captain, Navigator and Mate are forward of the mast, facing the crew. One student at the front of the crew has the ship mascot figurine ready, and another has been given the job of attaching the lei moa to the halyard and has the lei ready.

Captain: (calling everyone to attention and silence)
"IT IS TIME TO GIVE OUR PROUD SHIP THE NAME SHE WILL BEAR... WHAT IS THE NAME YOU HAVE CHOSEN?

The crew responds in one voice: THE ____________

Captain: "SO IT SHALL BE.. (to the Mate) Mr (or Miss) __________, HAVE THE MASCOT PLACED."

Mate: to the crewman holding the Mascot
" PUT OUR MASCOT IN THE PLACE OF HONOR "
crewman places mascot on pedestal and sees it is tied down properly, then return to his place

Captain: to the Navigator
" Mr. ____________, SET THE LEIMOA SO WE MAY KNOW OUR WIND DIRECTION

Navigator, to seaman holding Leimoa,"RAISE THE LEI MOA , READER OF THE WIND". Seaman attaches lei moa to the halyard, raises it to the top of the mast and secures halyard by tying it around the mast securely. He returns to his place.

Mate: reporting to the Captain, " ALLA IS READY FOR OUR VOYAGE, CAPTAIN."

Captain: to crew " ALL HEADS BOWED SO EACH MAY ASK HIS PRIVATE GOD FOR A FAIR VOYAGE"..... 5 second silence.....
"CAST OFF! ALL HANDS REPORT TO STATIONS FOR DUTY."

any simple ceremony like this will do. Note: Officers do no work, it is all delegated from Captain to Mate or Navigator to the crew .

SUGGESTED ACTIVITY FOR LANDFALL CEREMONY

All materials should be packed up by a specified time of day, in readiness for leaving the ship. Navigator informs Captain the ship has reached land. Mate then directs student to stand by the mascot, and another student to stand by the mast to take down the Leimoa.

Captain stands by mast, all students face him.

Captain announces:" We have completed our journey safely and we set foot now on this strange land we will call our own. (to the Navigator) Mr____ strike (take down) the Lei Moa , (to the Mate) Mr. _______, Get the Mascot ready for shore."

Navigator and mate sign the students to haul down the Lei moa and get the Mascot. They return to the mast as quickly as possible. When all are there, the Captain goes off the ship first followed by the Leimoa and the mascot, then the Navigator and the mate. The two crewmen follow behind them, and then the remainder of the crew start carrying off the boxes.* As soon as the deck area is cleared , the mast and stabilizers are taken down, and the railings, siding panels, and stakes are methodically taken down and neatly stacked. Everything is stored away properly, then meet in pre arranged place for their Landfall celebration.

* As soon as they are ashore the crewmen take the leimoa and the mascot to be stored. After this, the captain, mate and navigator become part of the crew since we assume they have assignments in helping to dismantle the ship and store things properly.

Main point: Keep it simple, but there is the custom of the officers being first ashore, and the leimoa can be viewed as a 'flag'so it should also go first, along with the mascot, who always gets preferential treatment!

VOCABULARY

(Hawaiian equivalent is in parenthesis)

AMIDSHIPS: middle section of the hull

BEAM: width of the ship

BOW(Ihu wa'a): front end of the ship

BOARDING THE SHIP: going onto the ship

BOARDING AREA: where the gangway connects to the ship

CHRISTENING: when name is officially given the ship (usually at the time it is launched). Absolute necessity for good luck in ancient times, now a legal requirement

DECK (Pola): the "floor"

DOGHOUSE (something like a hale); might also be a cabin, usually refers to place where ship is controlled

EYELET: carefully made holes in canvas, bound in brass grommets for protection

EQUATOR: equidistant midpoints between North and South poles

FOOD LOCKER: any closed space used to store food (room, box, refrigerator, <u>etc</u>.)

FORWARD: the front part of the ship, usually from the main mast to the bow

HO'E : paddle

HOKU: star

HOKU LE'A: star of gladness, the zenith star of Hawaii; Arcturus

HOKU PA'A: fixed star; Polaris, the North Star

HOKU HO'OKELE WA'A: literally "star navigating canoe"; Sirius

HORIZON: where sea (or earth) and sky seem to meet

KI'A: means stand tall; mast

LA or PE'A: sail

LASHING: use of line to tie two objects together in a specified manner. Lashings may also be short sections of line designated for a specific purpose

HALYARD ASSEMBLY: a pulley and line for raising and lowering flags, <u>etc</u>.

LATITUDE: imaginary lines drawn around the earth that are parallel to the equator

Vocabulary continued

LOG: a book in which all information concerning the condition of the weather, the ship, the ships company, unusual accidents, etc., are recorded VERY SUCCINCTLY

LONGITUDE: imaginary lines drawn between the North and South poles

KE ALANUI I KA PIKO O WAKEA: lit. the path at Wakea's navel; the celestial equator

KE ALANUI POLOHIWA A KANALOA: lit. the glistening black path of Kanaloa; the southern limit of the sun- Tropic of Capricorn

KE ALANUI POLOHIWA A KANE: lit. the glistening black path of Kane; the northern limit of the sun- Tropic of Cancer

MAKANI: wind

MASCOT: a figurine made by students of real or imaginary creature used as good luck symbol

MAST(ki'a): also called the stick. Large pole from which sails are hung, as well as navigation and weather instruments, and flags (identification, communication)

NAVIGATE (Ho'okele): to deliberately go from one place to another

NAVIGATOR (Ho'okele): (see kele in Pukui and Elbert) one that navigates

OFF-LIMITS AREA (Kapu): places where access is restricted, usually for safety reasons

PAEPAE: boom, used to extend sail from mast. Lei moa hung from paepae

PORT (Hema): left side of the ship (Hema is also South)

RAILING: called siding in our project. Closest Hawaiian equiv. is MO'O (lit. "lizard" a legend here!) which is the gunwale, pronounced gunnel

SIGHTINGS: seeing any unusual objects when aboard ship: animals other ships, etc.

SQUALL: sudden rain storm, usually very short and heavy

STABILIZERS: lines running fron the mast to sides of the boat to hold it in position

STARBOARD (Akau): the right sight of the ship (Akau is also North)

STEPPING THE MAST: the process of putting the mast into the ship

STERN (Muli <u>or</u> Hope): the very back end of a ship

STORES: ship stores are all the materials carried for repair or replacement of parts, for work to be done on board <u>etc</u>.

SUPERSTRUCTURE: anything built above the deck of a ship

TELL-TALE (Lei moa): very light weight, colored pieces of string or cloth attached to the rigging (lei moa to the paepae, or boom)of a ship that indicates wind direction. The lei moa, a feather lei or strips of colored kapa, served this purpose most elegantly

WA'A: canoe

WA'A KAULUA: double-hulled canoe

WA'A PAULUA: double-hulled canoe joined by three cross members ('IAKO)

ZENITH: highest point, as when a star is directly overhead

NAUTICAL CUSTOMS

- o Many ships today (and almost all of the ships prior to this century) have some special decoration at or near the bow. This might be painted on the hull, or be a carved figure of some kind. Originally these were representations of sources of special powers that would guide and protect the ship. Our ship mascot serves this purpose.

- o Ships have always been feminine in gender, no matter what the name. Seamen have very close bond of affection or sometimes thereverse for their ships.

- o All ships have names, from the earliest times, so far as we know. Un-named ships that have been launched seemed to be unlucky and ill-fated (as well as unprofitable); therefore, names are given at a christening immediately prior to launching.

  Today, in addtion to the name, a registration number is a legal requirement. The sequence of numbers and letters is a code that defines the type of ship, amongst other things.

  *** Students could have a "registration" number for their vessel, in addition to the name. For example:

  Teacher's initials/ # of boys/# of girls/their room #
  or as translated J.B. 12 14 3A

  Names may be of (1) persons, with feminine names given most frequently, (2) places, (3) famous events in history (4) animals andless frequently (5) plants. Today ships frequently have names that are contractions of company names or phrases. Sometimes they are acronyms.

  Senselessnames have always been considered bad luck and are rarely, if ever, used.

- o All ships and boats carry wind direction indicators. The simplest is a bunch of strings from old cloth tied to a ladder. The most elegant is certainly the Leimoa, and the most efficient isthe modern recording wind indicators.

- o Allships carry "colors"...their national flag, their company flag. Most of these are nto flown at sea because they would be ripped to shreds in no time. The student ship uses the leimoa raising and lowering as a substitute for the ship's colors in similar ceremonies.

- o The captain is in absolute command. He seldom speaks directly tothe crew as commands are passed down the chain of command.

- o Crew must abide by the chain of command rule: they speak directly only to their immediate superior, and only talk to anofficer if they are directly spoken to.

- o In ceremonies, officers precede the crew.