THE CASE OF THE STRONGEST CORD — STUDENT CORDAGE RESEARCH STATIONS

Let's Find Out! How was cordage used in old Hawai'i?

You will be assigned a group (A, B, C or D) and visit 4 different stations with your group (10 minutes per station). At each station, find pictures showing how cordage was used in old Hawai'i. Pick one cordage example at each station to record on an index card. Complete your index cards following the instructions and samples below. You are required to complete four index cards total!

We'll rotate in four rounds:

	Round 1	Round 2	Round 3	Round 4
Computers	A	D	C	B
Table 1	B	A	D	C
Table 2	C	B	A	D
Table 3	D	C	B	A

On your index card, include source and…
What is the example?
What is it used for, or how is it used?
Who used it?
Draw a simple sketch.

Example for a book:
Dunford, Betty. (Year published). *The Hawaiians of Old*. The Bess Press. Honolulu, HI. pages 95-96.
gill nets
used to catch fish
used by fishermen

Example for a Web site:

www.primitiveways.com/olona.html (today's date)
thread/*olonā* cord
lei-making
crafter/hula dancer

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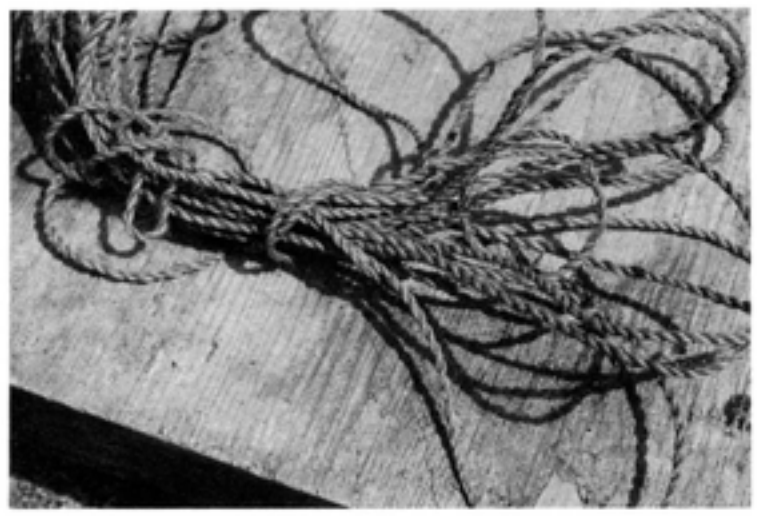
STUDENT READING



How would you build a house without nails or secure things without screws or strong glue? Early Hawaiians were skilled at constructing many things using cordage (string and rope) made out of fibers from plants. The cordage was used to fasten, bind, lift and pull things. For example, instead of building a house using nails, Hawaiians used cordage to construct their houses of wood and *pili* grass. Hawaiians made tools, nets, fish lines, fish hooks, musical instruments, games, weapons and more using cordage. Their feather capes, helmets, and containers were made with cordage. They even hauled huge *koa* logs down the mountain using ropes made from plant fibers.

Niu (coconut) husks made some of the best cordage. Cordage made from *niu* husks is called *ʻaha*. It was used in canoe-building because it doesn't slip and it gets tight when wet. Samuel Kamakau, a native Hawaiian historian who lived in the 1800s wrote that when building a canoe "half the task was in making the coconut cordage" (Kamakau, 1964). What did he mean?

Hawaiians made fishnets and fish lines from strips of bark from the *olonā* plant because it is resistant to water and doesn't stretch. When Western sailors first came to Hawaiʻi, they discovered how strong *olonā* cordage is. They encouraged Hawaiians to manufacture a lot of it. The cordage became a valuable trade item. In fact, well-made cordage was one of the most valuable trade items in early Hawaiʻi. It was so valuable, indeed, that those who grew the plants did so in a secret location. The *olonā* farmer was one of the wealthiest.

Before twisting or braiding fibers to make cordage, the plant fibers must be prepared. The husks of coconuts are soaked in salt water. Then the husks are pounded, cleaned, separated and dried. Preparing *olonā* fibers also takes time and skill. Hawaiians used shells to scrape strips of *olonā* on long hardwood boards. *Hau* bark, another plant fiber used to make cordage for nets, bowls and gourds, also had to be peeled and prepared.

Information about how to make coconut cordage and *hau* cordage can be found on the Polynesian Voyaging Society Web site in an article entitled *Plants Used for Building*

Canoes (Babayan et al., Not Dated). Sections of that article are adapted and reprinted below with permission from Polynesian Voyaging Society.

ʻ*Aha* (Sennit) – Made from Coconuts

People have made and used cordage for many centuries. It has been used to attach one object to another and to lift, pull, or secure things into place. Cordage is useful s well as decorative. ʻ*Aha* (coconut sennit cordage) is still being made in many places in the Pacific. Both the green and dry husks of the coconut are used.

Polynesian Methods for Preparing Coconut Fibers

Method 1

- Break the husk apart into sections. Turn over each section to expose the slick outer skin.
- Pound this outside portion. This breaks the inner fibers away from the outer skin.
- Soak the sections in sea water for several weeks. Then remove the long fibers to use for making cordage.

Method 2

- Break the husk apart. Remove some of the long fibers.
- Soak the fibers in sea water for eight weeks.

Pacific Islanders who use the green husk just remove the long fibers by pulling the husk apart and working the fibers into cordage.

Sennit used for canoe lashing must have a very tight braid and is extremely difficult to make. Because of the roughness of the fibers, only a few lengths can be made in a day.

Several different kinds of cordage were used throughout Hawaiʻi and the Pacific region. Bark from the *hau* (hibiscus) was easier to work with than coconut fibers. *Hau* bark strips are longer and when braided or twisted are very strong. *Hau* cordage was used for securing items such as *umeke* (bowls / calabashes), or rolls of *kapa* (bark cloth) or *lau hala* (pandanus leaf).

Making Coconut Cordage (Sennit)

1. Husk mature dry coconuts and break into 8 to 10 sections. Remove shorter fibers next to outer shell, at both ends of the husk, and discard.
2. Soak sections for two weeks, or until they are easy to work. Soaking fibers in running water helps in the cleaning process. Weight them down with a brick or stone when soaking.
3. Remove sections. Work sections by twisting or use table edge and press sections over the edge; peel and discard outer skin.
4. Beat each section with a wooden mallet. Use a piece of hard wood or a flat stone for an anvil.
5. Start beating. Beat sections starting from the center and working to the edge. Turn section around, repeat process to remove extra matter.
6. Rinse to “separate chaff" from fibers. Shaking the bundle helps to remove the "chaff." Tools like shells or a strong comb help in removing extra material. Work through fibers. This process cleans and untangles fibers. Tie each section around the middle. This is for easy handling.

Making *Hau* Cordage

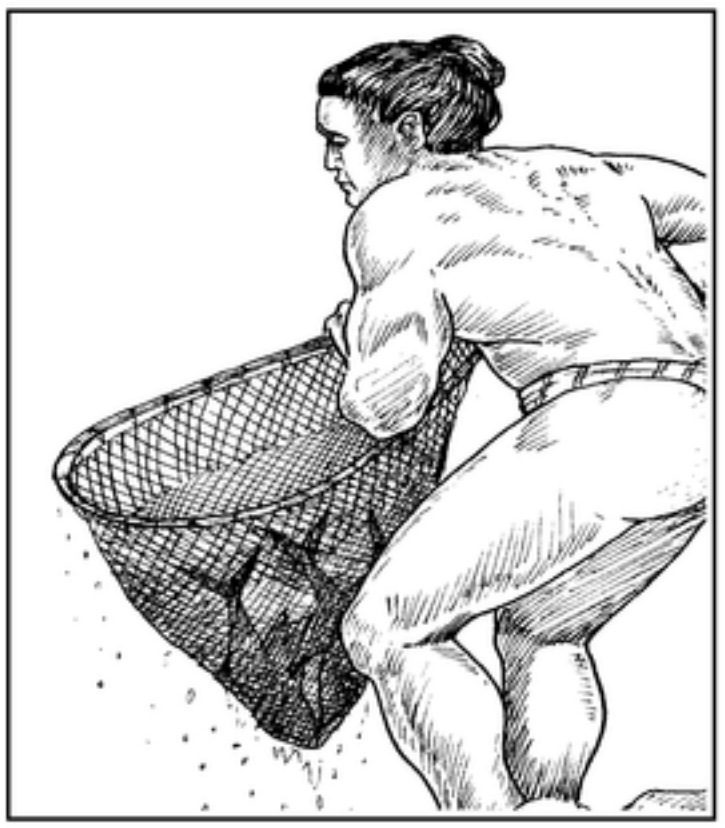
1. Ask an adult to help you cut a *hau* (hibiscus) branch. Select a straight branch with few branch scars.
2. Ask an adult to help you strip the outer bark (bast) using a sharp instrument (*ʻopihi* shell or knife). **Do not use a knife without adult assistance!** Peel the bark away from the branch.
3. If fine cordage is desired, scrape off the outer bark.
4. Soak the bark in water for about a week. Running water, such as in a stream would work best. You can also place the fiber in tap water. Change the water every few days to prevent the bark from rotting. The object of soaking is to soften the fibers so they can be separated into layers.
5. Take strips of the material and braid or twist to make cordage.
   - Take three strands of fiber, start each one about one inch from the other.
   - Place right palm over fibers. Place fibers on your leg.
   - Firmly roll the fibers downward towards your knee.
   - Keep adding fibers to lengthen the single fiber thread.

Another Method for Making *Hau* Cordage:

1. After all the fibers are cleaned, tie 15 fibers together with a knot. This will be used to make cordage.
2. Divide the fibers into three groups of five fibers. It is better if the groups of fibers are not the same length.
3. The knot may be held between your toes or tacked at the edge of a table. Braid the fibers.
4. Before you reach the end of a fiber group, add in a new group of 5 fibers. Individual fibers may also be spliced in as needed.

THE CASE OF THE STRONGEST CORD

HOW TO TEST CORDAGE



People use cordage (rope, string, line) for many purposes such as in fishing, boat rigging, carrying loads, climbing, hauling and lashing. Picking the right cordage for the right job requires knowledge of tensile strength (or breaking strength), stretch, flexibility, abrasion resistance and durability. If you will be using the rope with your hands, then the way the rope feels in your hand is important too!

Rope manufacturers use special machines called tensile test machines that pull rope in opposite directions. The machine records the breaking point of the rope—we can think of the breaking point in kilograms or pounds of force on the rope. We don't have a tensile test machine, but there is another way we can test breaking point of cordage using scales and weights. Can you design a testing device in class?

Climbers test rope strength using a drop test. Climbers want to be sure their safety lines will hold their weight in case they fall! For a rope to pass the drop test, it must not break after five test falls. A weight is attached to the rope and the rope is dropped a specific number of meters. Can you design a drop test for our cordage materials in class?

To test for abrasion resistance, the cordage needs to rub against a rough surface. You could pass a length of cordage over sandpaper fixed to the edge of a desk, load the cordage with a weight, and then rub the cordage back and forth across the edge. Record the number times you rub the cordage back and forth before it breaks.

Another important quality to think about is knot strength. How well does your cordage hold a knot? Test this by knotting two pieces of cordage together and loading the cordage with weight. Be sure to use the same knot for each trial of an experiment. Does wetting the cordage affect knot strength? How?

To discover how much cordage stretches, measure the length of your cordage. Then tie a weight to the cordage, allow the cordage to hang for a set amount of time, and then

measure the length of cordage again. What is the difference in length before and after hanging weight to the cordage?

- ✓ What would you like to find out about cordage? Decide on one or two variables you would like to test and design an experiment using Learning Log sheet 3 to guide you.

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LEARNING LOG 3

NAME_____ **DATE**_____

A Scientific Investigation

A. Problem: (What I want to find out)

Hypothesis: (If…then…because…)

B. Materials: (What I used to do this investigation)

C. Procedure: (Step-by-step directions for what I did)

D. Data: (What happened, my results)

E. Analysis of data: (True statements about my data)

F. Conclusion: (What the answer to my question is, and an explanation of the outcome)

G. Measurement: Explain how you tested the strength and flexibility of your cordage. Why was it important to use standard units of measuring when comparing different types of cordage?

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LEARNING LOG 4

NAME_____ **DATE**_____

A DAY IN THE LIFE OF OLD HAWAIʻI

Imagine you live in old Hawaiʻi. Think of all the ways you rely on cordage for daily living. Answer the following questions.

Where in the *ahupuaʻa* would you live to be able to find materials for making cordage?

What would you do each day? Would you need cordage for any of your activities?

What materials, foods and supplies would you need to survive, and where would you get them?

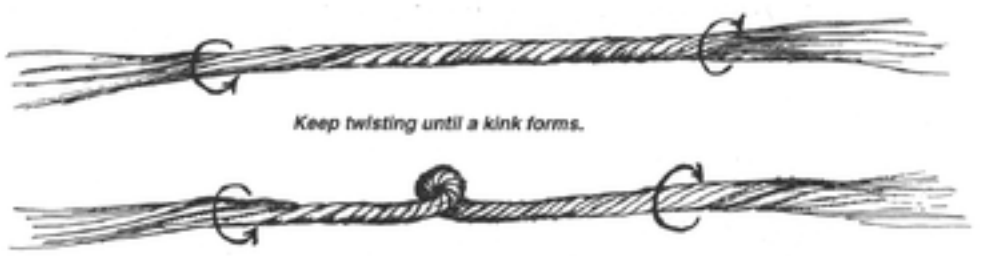
What kind of trading would you do with other people and why would you trade?

Use your ideas to complete a pre-writing exercise. Then write a short essay that describes a typical day in the life of a Hawaiian in the *ahupuaʻa* system. Be sure to include information that you learned about cordage in old Hawaiʻi.

THE CASE OF THE STRONGEST CORD — CORDAGE-MAKING INSTRUCTIONS

MAKING CORDAGE: FINGER TWINING METHOD

1. A bundle of plant fiber half the thickness as the finished cordage was prepared.

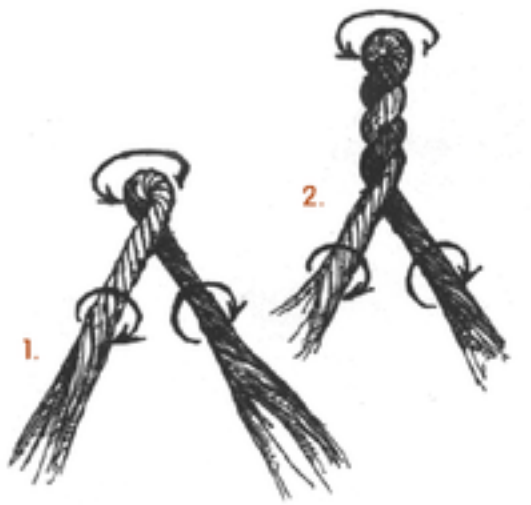


2. Both hands were placed one third from the ends of the fiber bundle. There would be six to twelve inches of fiber between the hands.

3. The fiber bundle was twisted (twined), in a clockwise direction, using both hands. See image above. Twisting the fibers tightly made a single, even strand of cordage.

4. After twisting, a kink would form in the middle of the strand. See image above.

5. As the twisting continued, the kink brought the single strand together and made a double cord. (See numbers 1 and 2 in image.)



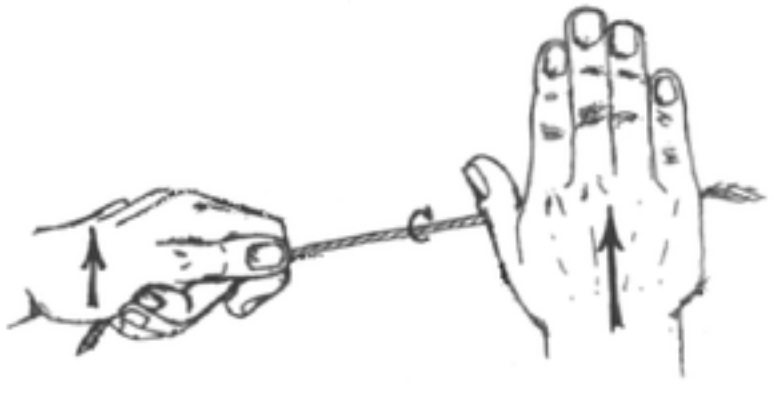
6. Twining the fibers in a clockwise direction produced a S-twist to the strand.

7. Twining the fibers in a counter-clock-wise direction produced a Z- twist.

MAKING CORDAGE: LEG ROLLING METHOD

1. The leg rolling method was started with a few plant fibers.

2. Using the right hand, the fibers were rolled under the palm against the right thigh.



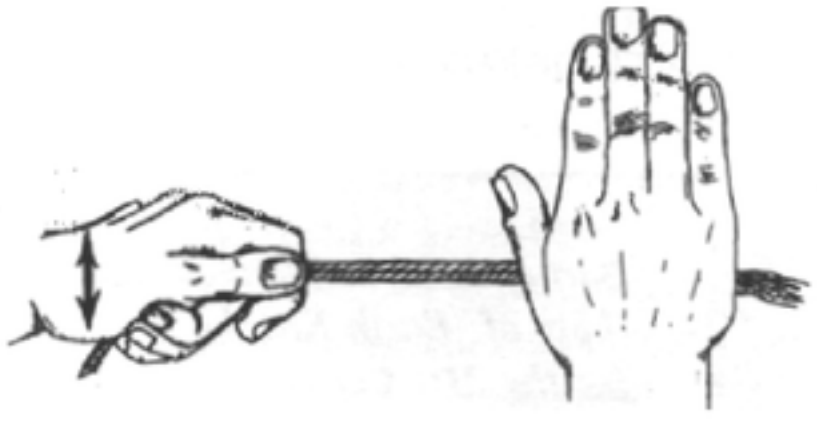
3. Rolling was done with a pushing motion towards the knee. This made a one-ply strand with a S-twist.

4. More plant fibers were taken and twined with the same method.

5. Then the two sections of cordage were held together with the left hand.

6. The right hand pulled the two strands together towards the hip.

7. Pulling the strands together towards the hip made a two-ply cord with a Z-twist.



MAKING CORDAGE: SPLICING

A problem with making cordage was that the fiber lengths were too short for the production of long strands of cordage.

Splicing in new lengths of fiber made long strands of cordage possible. Splicing is a technique where, before the first strand of fibers had run out, new fibers were added into the twining process.

Figure 1: Using either the finger method or the leg rolling method, the strands of fibers were twined until three to six inches remained. Somewhere between three to six inches from the end, a new strand of fibers was placed parallel with the original. These new fibers overlapped an inch or two beyond the cordage.

Figure 2: The new strand was twined in with the original.

Figure 3: The twining continued as before.
The excess overlap fibers were cut or clipped so that the cord was smooth and strong.

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