Theme D

Cooperative Kite-Making

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SUMMARY

Adaptable Levels
Grades 2-12

Related Themes
PPE, CCC

Values
Appreciation, cooperation

Skills
Communicating, researching, cooperating

Integration
Art, social studies, math, science, literature

PURPOSE

To stimulate research into the aesthetics, traditions, skills and materials used in kite-making; to reinforce cooperative learning concepts and skills.

THEME STATEMENT

Aesthetics, Celebrations & Values (ACV): All people need things of beauty, times of leisure and celebration, and a sense of values and service in their lives.

SUGGESTED TIME

Two to five sessions of thirty minutes each.

KEY VOCABULARY & CONCEPTS

- aerodyne = heavier-than-air machine
- bamboo = flexible, light-weight indigenous wood
- frame = kite skeleton
- spine = backbone or longest sticks
- support spars = reinforcing traverse or cross-pieces for the frame
- lashing = cord fastings for joints of frame and spars
- bridle = one or more strings holding kite at correct wind angle
- cover = light, airtight, strong paper, cloth or mylar

MATERIALS NEEDED

- eight to twelve 40-inch bamboo rods (one for each circle). You may substitute any material which is strong, lightweight, straight-grained and flexible such as balsa, spruce, white or ponderosa pine or cypress wood strips or dowel rods, plastic or plexiglass rods, wire, old outdoor porch shade strips to be used for the circular frames and for the two cross-pieces or spars per frame. Be sure, prior to bending the frame, that you soak the wood in warm ammonia water or heat it over a candle flame.
- string for lashing ends and crosspieces of spar (duct tape may be used but adds weight).
- different colored sheets of Mylar or waxed florist paper.
- hot glue gun and glue sticks (or wood and plastic glues) for lashings and covers. Be sure to allow time for the latter to dry.

- directions and/or patterns for frame and covers
- colored markers for decorations
- compass or string and pencil for drawing circles of correct sizes
- razor blades for slitting ends of rods or short plastic tubes for inserting ends (may be pre-cut by adult)
- variety of kite books
- miscellaneous: scissors, tape, rulers, sandpaper, rubberbands, etc.

BACKGROUND INFORMATION

The kite may be designed to be airborne or as decorative classroom mobile attached to the ceiling with fishing line and paper-clip hooks. This lesson, based on the centipede kite, may be adapted for any kite design ranging from a very simple "Cambodian Snake" to the elaborate parafoil kites by changing sizes, shapes and decorations of the head and tails. For younger students, some materials (cutting, taping and bracing the frame and attaching the Mylar or florist paper to the frame) may be prepared ahead. These preparations also make a good family-style activity.

INITIATION (Inquiry, Preview, Involvement)

1. Introduce the Chinese national holiday of "The Festival of Ascending on High" on September 9 by displaying a simple kite and/or sharing the foreword from *Dragon Kite of the August Moon* (Student Handout #1) and Dolin's *The Complete Beginner's Guide to Making and Flying Kites* (Student Handout #2). If time permits, integrate other Asian legends on kites.

2. Divide the class into groups of three to five members. Instruct each group to formulate a creative plan and construct part of a mystery kite representative of Asian cultures. The kite will take shape and character as the components are assembled.

3. Provide each group with time limits, materials and instructions (frames may be prepared ahead if time is a factor.):

- patterns and sketches for making three or more decorated circle frames of the same or varying sizes to contribute toward an imaginary animal representative of Chinese culture
- sticks for frames (one per frame) and spars (two per frame)
- string for spars
- sheets of varied colors of Mylar
- glue for wood and Mylar
- colored markers and patterns

4. Emphasize that the kite must be as weightless as possible to fly. Review principles of air flow and flight with older students.

DEVELOPMENT (Instruction, Data Collection, Organization)

1. Ask each group to develop a plan for cooperative work within and between groups and for constructing the frames. One group may be assigned to create a head for the mystery animal and another the tail, including the tail bows.

2. Set up and review a display of "how to" and illustrated tradebooks for reference.

3. Check progress of each group and reinforce time constraints as circular frames are assembled and decorated. Ask each group to select symbols for Asian cultures to incorporate into the designs.

EXTENSION/ENRICHMENT (Idea Articulation, Ownership, Experimentation)

1. At the end of the first session, discuss actions that facilitated the construction process and discuss plans for the following session focused on combining segments of the animal into a kite (see "Assessment of Achievement" section).

2. Lay out each group's frames, share meanings of the symbols and colors used, and plan for the most aesthetic arrangement of the centipede (dragon or whatever) along four cords, attaching frames approximately ten inches apart. Add tassel tails or strip tails to ends of each horizontal support spar for the consistency needed to "pull" centipede frames together.

3. Fly or hang the product for manual and visual appreciation.

ASSESSMENT OF ACHIEVEMENT

- List questions identified by students under "Key Questions" below. Preceding and following each session, review current data to encourage further in-depth research and revisit questions each session.
- Ask groups and class to assess *products* with rubrics below.
- Ask groups and class to assess the *cooperative processes* using rubrics similar to those below.
- Ask individuals to write a paragraph summarizing "Key Questions" and then to compile by groups an essay representing all contributions.
- Students assess their performance and product with rubrics adapted from the following (select whichever items in parentheses apply to the given assessment):
  - 4 = Our (product) (process) truly reflects (our creativity in representing Asian cultures) (high standards of cooperation).
  - 3 = Our (product) (process) will be improved by making the following revisions: *student explains revisions .*
  - 2 = Our group needs guidance in improving our (product) (process).
  - 1 = Our group needs immediate assistance with (product) (process).

KEY QUESTIONS

- In constructing a kite which is characteristic of Asian cultures, what questions do we need to ask and research during the planning stages?
- How did cooperative groups assist the construction? How could our process be improved?
- What did you learn about values and celebrations of Asians during your research and construction stages?

ALTERNATIVES

- Precede the lessons with an in-depth study of the principles of flight.
- Precede or infuse the lessons by collecting and arranging a display of art elements and symbols representative of Asian cultures.
- Ask each group to select a different type and design for kites but limit materials to encourage cooperative sharing.
- Arrange for a kite competition as the culmination of the lessons.
- As a motivator, share several examples of Asian literature on kite making and flying (see "References and Resources" below).

REFERENCES & RECOMMENDED RESOURCES

The following resource is for teacher background:

- Tyrell, Susan. *Kites: The Gentle Art of High Flying*. Garden City: Dolphin Books/ Doubleday & Company, Inc., 1978. (ISBN 0-385-13055-4)

  Gives historical accounts of the Chinese festival of "Ascending on High" (September 9) and Asian customs of kite making and flying; includes flying and materials instructions and black-line sketches of many kite designs. This is an excellent resource for students as well as teachers.

The following resources are for student research:

- *Create-A-Kite: How to Build and Fly Your Own Kites* (A Fireside Book). New York: Simon & Schuster, 1977. (ISBN 0-671-22883-8)

  Includes colorful illustrations and patterns for 20 kite designs.

- Dolan, Edward F. *The Complete Beginner's Guide to Making and Flying Kites*. Garden City: Doubleday & Company, Inc., 1977. (ISBN 0-385-04905-6)

  Gives background and simple sketches of designs for kites.

- Nunes, Susan Miho. *The Last Dragon*. New York: Clarion Books/Houghton Mifflin Company, 1995. (ISBN 0-395-67020-9)

  Tells a story about a boy's adventures in a Chinatown community for younger children with watercolor illustrations and author's note for all ages.

- Reddix, Valerie. *Dragon Kite of the Autumn Moon*. New York: Lothrop, Lee & Shepard Books, 1992. (ISBN 0-688-11030-4)

  Following an explanation of kite traditions of Taiwan, relates the story through illustrations and words of a boy who chose to fly his dragon kite for his ill grandfather.

- Wiley, Jack, and Suzanne L. Cheatle. *Dynamite Kites: 30 Plans to Build and Fly*. Blue Ridge Summit: TAB Books Inc., 1988. (ISBN 0-8306-2969-6)

  Includes simple bulleted instructions and illustrations for design variables, methods and materials.

- Yolen, Jane. *The Emperor and the Kite*. Cleveland: Collins World Publishing Co., Inc., 1967. (ISBN 0-529-00255-8).

  A value-based story about a tiny princess for younger children with appropriate illustrations for older students interested in line and color design.

STUDENT HANDOUT #1:

"Dragon Kite of the Autumn Moon"

[Foreward from Reddix, Valerie. Dragon Kite of the Autumn Moon*. New York: Lothrop, Lee & Shepard Books, 1991.]*

The island of Taiwan (often called Formosa from 1590, when the Portuguese landed there, until the time of the Second World War) lies one hundred miles from the mainland of southern China. The custom of celebrating a special "Kite's Day" in the ninth month of the year, six days before the rising of the full moon, was probably taken to Taiwan by the Chinese, who began to settle there in the seventh century. Tradition holds that if the kites are set free at the end of the day, they will carry all troubles away with them. To avert inheriting the misfortune carried by the kites, they must be burned when they fall to earth.

STUDENT HANDOUT #2:

History of the Kite

[Excerpt from Dolan, Edward F. The Complete Beginner's Guide to Making and Flying Kites*. Garden City: Doubleday & Co., Inc., 1977, pp. 5-9.]*

Many people like to think that the kite was born when some ancient thinker saw a leaf floating in the air and wondered if he could make it fly high by attaching a length of corded vine to it. But no one really knows when or how the kite came into being. The best guess is that it originated in China and then slowly made its way throughout the rest of Asia and into Europe.

Chinese folklore abounds with legends of the kite. For instance, an ancient military leader is said to have captured a fortress with its help. After an unsuccessful attack, he flew a kite up over the fortress walls and used the flying line to measure the distance between them and his camp. Then he ordered his troops to burrow a tunnel that distance. The soldiers emerged inside the fortress and quickly overwhelmed the surprised defenders.

Centuries later, so another story goes, an emperor cleverly employed the kite as a danger signal. Though threatened by invaders, he could not keep his troops constantly on guard since they were also farmers who tended his surrounding fields. He solved the problem by flying kites from his palace walls whenever observers sighted the enemy. On glimpsing the kites, the farmer-soldiers would drop their tools and pick up their weapons.

Traditions, as well as legends, soon surrounded the kite in China. The people took to sending their kites aloft with reeds or small harps attached so that the humming and wailing sounds would frighten away nighttime intruders and evil spirits; in fact, the Chinese term for the kite—*feng cheng*—comes from the small harps and means, literally, "wind harp." Also seeing the kite as a symbol of good luck, the people decorated it with a crane or a turtle to insure long life or shaped it as a dragon to symbolize their gratitude for a prosperous year. In one ancient ceremony, the family sent a kite far into the distance on the eldest son's seventh birthday. It was then cut free and allowed to float away, carrying with it all bad luck for the child.

Of course, the kite was also flown for pleasure. Many Chinese thought that its peaceful flight aided contemplation. All saw it as symbolic of man's ever-rising aspirations.

Wherever it went, the kite became as much a source of legend as it was in China. The Polynesians told stories of ancestors who communicated with their gods on high via the kite. The Japanese cherished the tale of the thief who rode a kite to the top of a castle in an effort to steal two ornamental fish of solid gold there. The Koreans immortalized the general whose kites inspired his troops to engage and defeat an invader force; he secretly launched a number of kites, all with lanterns attached, above his camp and then spread the word that the lights in the night sky betokened the friendship and support of the gods. The people of Crete invented the myth of Icarus, the boy who donned wings of wax and flew into the sky, coming at last so close to the sun that the wings melted and he fell to his death. Many mythologists believe that the tale stems from early Cretan efforts to use the kite for manned flight.

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And in every new country, tradition joined the mounting legends. In Thailand, kites were flown as decorations above the royal palace and were sent aloft to invite the speedy arrival of the monsoon season, so beneficial to the nation's farming. In Japan, May 5 continues to be observed as "Boys Festival," with the day being devoted to flying kites in honor of good sons. Prior to World War II, the people on the Japanese island of Tokushima followed their old annual tradition of raising the largest kite in the world—a giant weighing 1,700 pounds and measuring sixty-five feet in diameter. Called the *Wanwan*, it was made of 2,500 sheets of paper and used ten lengths of ship's hawser, all bundled together, for a tail.

Practical work was soon added to the legends, the traditions, and the pleasures of flying. The early peoples of Malaysia and the South Pacific fished with kites made of plant leaves. Portuguese sailors of the fifteenth century sent kites up when a ship had to be pulled free of a harbor whose surrounding hills blocked off the wind. The seventeenth-century Japanese architect, Kawamura Zuiken, used kites to lift workmen to the roof of a temple under construction. In 1822, an English schoolteacher named George Pocock lashed two giant kites to a lightweight carriage of his design. The kites—one fifteen feet long in the spine, the other twelve feet—were known to tow the carriage along at speeds up to twenty miles an hour.

Here in our own country, almost a half-century before Pocock's birth, Benjamin Franklin unreeled a kite into a storm and, taking a painful shock for his trouble, proved that lightning and an electrical current are the same. The experiment marked one of the earliest scientific uses to which the kite was put. Out of the flight came new understandings of electricity and the invention of the still-in-demand lightning rod.

At about the time of Franklin's "Philadelphia experiment," as it was called, a Scottish astronomer, Dr. Alexander Wilson, determined the temperatures at higher altitudes by flying kites carrying thermometers. In the nineteenth century, English meteorologist E. D. Archibald tied anemometers to kites and dispatched them to record wind speeds at various altitudes.

Some of the most interesting work with the kite was done at the turn of our century, when experiments were in full flower to satisfy that age-old craving to fly. Some men were testing balloons, gliders, and assorted "flapping wing" machines. Others were concentrating on kites able to lift a man high, hoping that such kites would help to attain an understanding of the aerodynamic factors necessary for that miracle sure to come—powered flight. Among the aeronautical pioneers working with kites were Lawrence Hargrave, B. F. S. Baden-Powell, the telephone's Alexander Graham Bell, and the Wright brothers.

Hargrave, an Australian, first tried to build "flapping wing" machines in the 1880s and then, after several disappointments, turned to the kite. He eventually designed a model that he called the "cellular kite." It could lift extremely heavy weights, and in 1894, he sat in a sling below four of his cellulars and rode them to a height of sixteen feet. He could have gone higher but, for safety's sake, decided to come back down. The cellular has been called one of the great modern innovations in kite design. Today, we know it simply as the box kite.

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Englishman Baden-Powell, the brother of the founder of the Boy Scouts, is credited with the development of the first truly reliable kite system for lifting a man. He designed a six-sided kite called the "levitor". . . that, when flown in trains of four to seven, could lift a man to a height of one hundred feet or more. The "pilot" flew in a basket below the kites, with his altitude controlled by ropes extending down to a ground crew. The British government was much impressed by the levitor system and planned to use it for military observation during the Boer War. Baden-Powell and his kites—each of them thirty-six feet long—were sent to South Africa, but the fighting had ended by the time of his arrival.

For his aeronautical research, Bell developed what is known as the tetrahedral kite. Considered as much of a design innovation as the box kite, it was constructed of sticks arranged in one or more triangular sections, called "cells." Bell began in the 1890s with a one-cell model and then gradually increased the number of cells until, in the early 1900s, he was able to build the "Cygnet" (meaning "young swan"), a monster forty feet long and containing 3,393 cells. Weighing over two hundred pounds and towed by a steamer, it carried a man 168 feet above Nova Scotia's Baddeck Bay. The tetrahedral remains a popular kite to this day for those builders who enjoy trying their hand at especially odd-shaped kites.

As for the Wrights, they were especially interested in what could be done to control an aircraft when it was struck by sudden gusts or up- and down-drafts. As they saw the problem, the pilot was helpless to do more than shift his weight and hope for the best. And so they began a study of soaring birds and soon found that such fliers as hawks and buzzards twist their wing tips to control flight. The brothers achieved a similar control in 1899 with a "warping kite," a kite whose surfaces could be changed to meet varying wind conditions. Armed with what they had learned, the Wrights then built their first "flying machines" and went on to Kitty Hawk, North Carolina, for their historic flights.

Once powered flight was here, interest in man-lifting kites dwindled. But the kite men could be content that their studies had helped pave the way to the airplane. As for the kite itself, it continued to do yeoman's duty. With a camera attached, it flew above San Francisco and took a series of historic pictures of the devastation left by the great earthquake and fire of 1906. In its box form, it was sent aloft from weather stations throughout the world to make meteorological observations, a job that it held until replaced by the airplane and the weather balloon in the 1930s. In one of its latest designs—the para-wing—it has led to the development of the "flying jeep" (an experimental craft capable of hauling loads of 1,000 pounds for short distances), the para-glider for bringing astronauts back to earth, and the free-floating aircraft responsible for one of today's most popular sports—hang gliding.

But, most important of all, the kite has continued to do, in our century, the work that it has always done best. It has continued to bring pleasure to countless builders and fliers of all ages, of all occupations, and of all countries. Hopefully, you are the newest addition to their ranks.

STUDENT HANDOUT #3:

Instructions: Caterpillar/Dragon Kite (Version 1)

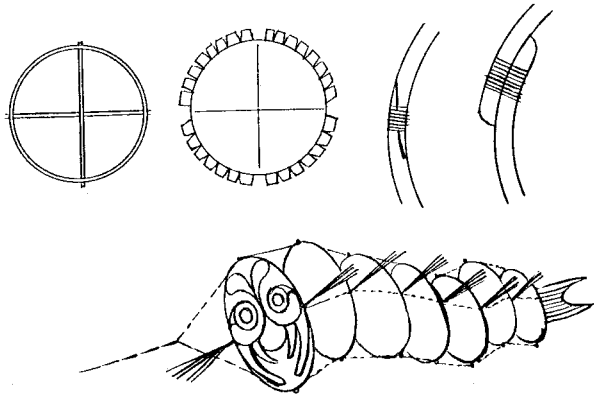
[From Dolan, Edward F. The Complete Beginner's Guide to Making and Flying Kites*. Garden City: Doubleday & Co., Inc., 1977, pp. 137-8.]*

MATERIALS:

- seven bamboo framing strips ($^1/_8$" x 48")
- fourteen dowel braces ($^1/_{16}$" x 16")
- cover and tail material
- working equipment

The caterpillar kite is sure to dazzle your friends, just as it has been dazzling the people of Asia for centuries. It consists of a series of disks connected by lengths of string. The disks ripple as the wind strikes them, giving the impression of a great caterpillar inching its "up-and-down" way through the sky.

Your first job of course is to fashion the disks. Shape each bamboo strip into a circle and reinforce it with two crossed bracing dowels. As shown in the illustration, each circle may be completed in either of two ways—by overlapping the ends of the strip or by shaving the ends into points whose flat sides meet.



Cover each circle with a paper disk. Let each cover have a 1" overlap that is divided into tabs 2" or 3" wide for neat folding. The disks are then connected to four lengths of string that run the length of the "caterpillar's" body; the disks should be set at 12" intervals along the strings. Last, a tail should be cut to the shape shown in the illustration and attached to the seventh disk.

The kite is flown with a two- or four-leg bridle. The front disk is usually painted with a happy face. Alternately placed disks of green and silver give a fine "caterpillar" effect. Reeds from a broom add a nice effect if attached in small clusters to either side of each disk.

The kite may be transformed into the traditional Chinese dragon, one of the largest of kites flown in Asia, by making each disk successively smaller all along the length of the body.

Though seven disks have been used here, you may add as many as you wish to the caterpillar or the dragon. Some dragons run to a length of fifty feet or more and require a team of men to get them into the air.

STUDENT HANDOUT #4:

Instructions: Centipede/Caterpillar Kite (Version 2)

[SOURCE: Wiley, Jack, and Suzanne L. Cheatle. Dynamite Kites: 30 Plans to Build and Fly. Blue Ridge Summit: TAB Books Inc., 1988.]

This kite is a series of flat kites linked together with strings. The same basic kite can be either a centipede or a caterpillar, depending on how you paint and decorate it (see diagrams next page).

FRAMES:

- Eight separate ring frames are required. Each frame is the same and requires three bamboo sticks. It is important to have the frame as light in weight as possible. Therefore, you will need to use bamboo strips that have the smallest cross-sectional size compatible with adequate strength.
- The longitudinal and cross sticks are 15 inches long and, for the 12-inch diameter circle, you will need a 40-inch-long stick.
- To make a frame, mark the center point on both the longitudinal and cross stick (see figures).
- Glue and bind the sticks together.
- Form a 12-inch diameter circle from the 40-inch-long strip.
- Splice the ends of the strip together as shown in the figures.
- Glue the joint and lash it with string.
- Glue the ring and lash it with strings to the longitudinal and cross sticks.
- Repeat for the other seven frames.

COVERS:

- A separate cover is required for each fame. You can use different colors for each frame or make them all the same color. Mark the pattern in the figure on the covering material.
- Cut the covering material to the pattern, using the appropriate method of joining, to form the sleeves and hems. Repeat for the other seven frames.
- Attach the covers to the frames with the circle sticks passing through the sleeves.

ASSEMBLING THE KITE:

- Link the frames together ten inches apart, on four strings.
- Tie the strings to the longitudinal and cross sticks outside the circle frames.
- Use a two-string bridle on the forward, or face, kite. The upper attachment is to the longitudinal stick above the upper circle stick attachment; the lower attachment is to the longitudinal stick below the circle stick attachment.
- Tie the other ends of the strings in a loop or to a small plastic ring.
- You can add a single tail to the last circle form.

VARIATIONS

- Instead of one tail, you can add small decorative tails or streamers to the ends of the cross sticks of each frame (see figures).
- You can use circles that are six inches or less in diameter to three feet or more. You also can vary the number of frames you use. Keep in mind, however, that the more rings you use, the more difficult it will be to fly the kite.
- A popular variation uses progressively smaller ring diameters to form the kite. Another choice is to place the rings progressively closer together. This method works well when progressively smaller rings are also used.
- You can use long cross sticks with the ends extending well beyond the edges of the rings. You can extend the longitudinal sticks in the same way.

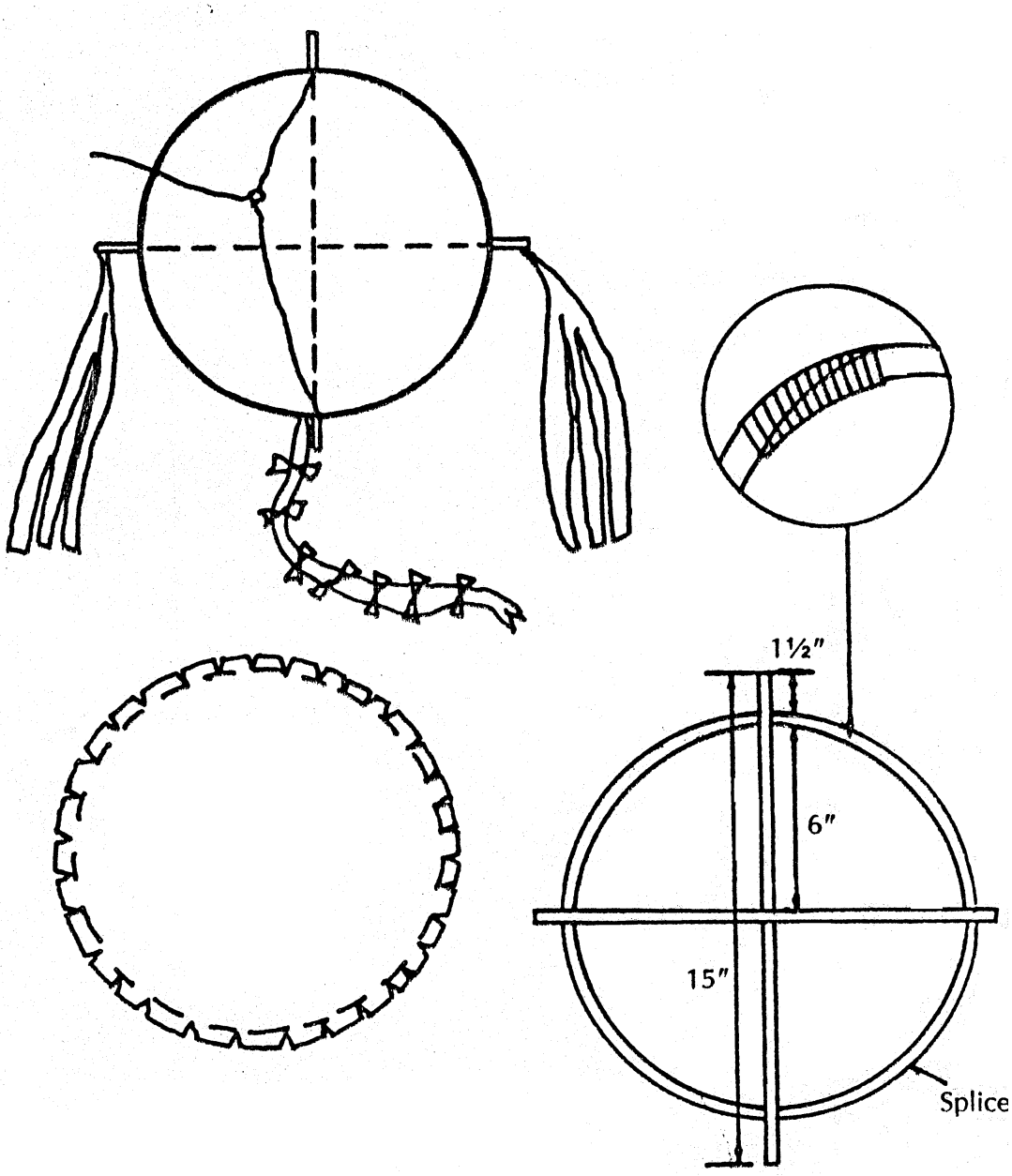


FIGURE #1 - #4:
Illustrates the different components of the centipede/caterpillar kite as described in Version #2.