

Artful Aerodynamics



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The combination of lift and drag that makes kites fly also makes designers' minds soar.

Humans spent centuries dreaming of flight, inspired by the graceful abilities of birds. From the tethered flights of ancient Asian cultures and Leonardo da Vinci's imaginative flying machines to the Wright brothers' first manned flight, kites have served as a bridge, lifting human imagination into the sky.

The materials are simple: a bit of basswood or reed for the frame, paper to cover it, a length of string, and something to hold as it soars above. The real creative work lies in the design.

The variety of kites is nearly endless, but they all rely on the same three forces to achieve flight: lift, drag, and gravity. Lift is the upward force that pushes the kite into the air. Drag is the backward force caused by friction that acts in the opposite direction of the kite's motion. Earth's gravity is the downward force that keeps you on the ground and causes objects to fall. Designing a kite requires balancing three forces: the upward lift, the backward drag, and the downward pull of gravity.

As a kite is flying the wind is blocked by the sail of the kite and is forced to move around it. Successful flight of a kite occurs when more air is forced under the sail than over, creating lift and overcoming the downward force of gravity. Drag will still pull the kite backward, but the kite line will prevent the kite from moving backwards.

Most kites need what is called a bridle. The bridle helps the kite obtain the best flight angle, which allows more air to be directed below the sails. The bridle is a length of string that connects the flying line to the kite at two points. The exception is the box kite, which only needs a single connection point. The main flying line attaches to the bridle at a spot called the tow point. Adjusting the tow point up or down changes the kite's angle and affects its flight.

To attach the bridle, start by finding the kite's fulcrum—the balance point where it pivots evenly, much like the center point of a seesaw. You can calculate this precisely using equations or find it manually by holding the kite at arm's length and adjusting along its vertical axis until it balances. Once located, attach the bridle to two points along the horizontal axis at the fulcrum.

Every kite also needs a tail. While it adds a splash of color, its primary purpose is to stabilize the kite during flight. The tail should create just enough drag to keep the nose of the kite lifted.

Now that you understand the science of kite flight, design one that reflects your unique creativity, then build and launch your artistic creation!



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Materials (required)

Aleene's Quick Dry Tacky Glue, 4 oz (23884-1104); share one bottle between two students

Surebonder Plus Series Dual Temp Glue Gun, (23635-1002); share one between four students

Surebonder Clear Stik All-Temp Hot Glue Sticks, pkg of 50, 4" (23604-1504); share one package across class

Beadalon Dandyline Synthetic Beading Thread, White, 0.15 mm, 25 m (60668-1046); share one roll between two students

Suggestions for building the frame

Knot-It Waxed Brazilian Cord, choose from a variety of colors, 472 ft (73560-)
Realeather Waxed Polyester Thread, choose from a variety of natural colors, 4 oz, 150 yd (63012-)

Creativity Street Wooden Dowel Rods, package of 12, 1/4" dia, 36" long (60448-1436)

Midwest Products Genuine Basswood Strips, 36 pieces, 5/32" x 5/32", 24" long (33300-2532)

P.L. Butte Round Reed, #3 Round Reed, 1/8" x 750 ft (83312-1003)

P.L. Butte Round Reed, #4 Round Reed, 3/16" x 750 ft (83312-1004)

Suggestions for covering the frame

Hygloss Transparent Cellophane, choose from an assortment of colors, 20" x 25 ft (11219-)

Fadeless Art Paper, choose from an assortment of color packs, 4 rolls, 48" x 12 ft 50 lb (12915-)

Blick Colored Tissue, 100 sheets, assortment of 20 colors, 20" x 30" (11308-1003)

Black Ink Thai Unryu Papers, choose from a variety of colors, 25 gsm, 25" x 37" (11234-)

Suggestions for the handle

Creativity Street Wood Turnings, assortment of sizes and shapes, 5 lb bag (28978-1005)

Creativity Street Wooden Dowel Rods, Pkg of 12 1/4" dia 12" (60448-1412)

Note: Instructions and materials are based upon a class size of 24 students. Adjust as needed.

Preparation

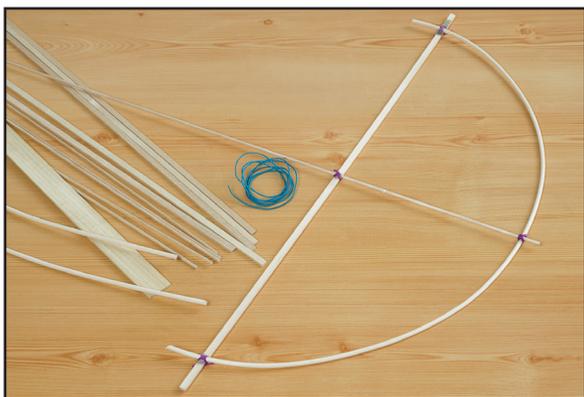
1. Research kite design. Look at a variety of manufactured, commercially available kites. Take note of design structure, proportions, and bridle placement.

Process

1. Create a rough sketch of the overall shape of the kite.
2. Consider what kind of frame design could support the structure and shape of the kite.
 - a. Is your design flat, or dimensional, like a box kite?
 - b. What is the length of building materials available?
 - c. How will each piece of the frame connect?
 - d. Where and how will the sail be attached to the frame?



Step 1: Sketch out the basic plan and design for the construction of the kite and create a basic scale model in paper.



Step 2: Use reed and basswood to construct the frame of the kite.



Step 3: Cover the frame with paper.

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Process, continued

3. Draw a frame structure on the original sketch and assign measurement estimates to the drawing.
4. Use scrap paper to construct a rough scale model of the kite. This helps identify potential design issues before building the full-scale version.
5. Gather basswood and reed to construct the frame. Using the planning sketch as a guide, lay all components flat on a table, adjusting and cutting each piece to size. When connecting two endpoints, allow for some overlap at the attachment points to ensure a secure bond. It's better to cut pieces slightly longer than needed—you can always trim excess material, but you can't add it back.
6. To join pieces at a 90-degree angle (forming a T or X shape), lash them securely. There are several ways to lash materials together, but the most common is square lashing, which prevents the pieces from sliding or becoming unstable. To lash, tie a knot at the cross points of the two pieces, forming an X shape with the string around the T shape of the frame. See figure 1 for reference.
7. Once all joints are secure, apply a drop of hot glue to each attachment point. This ensures stability, even if the knots are not perfectly tied.
8. Use the frame of the kite as a template for the sails. Place the desired paper underneath the kite and trace around the kite, giving about a 1/4" to 1/2" border. Remove the kite and cut the paper.
9. Use Aleene's Quick Dry Tacky Glue to attach the paper to the frame. When possible, wrap the edge of the paper around to the other side of the building material. Burnish the paper, making sure there are no air pockets or unattached areas.
10. Find the fulcrum and attach the bridle. Use a square knot to attach the Beadalon Dandyline Synthetic Beading Thread. The length will be dependent on the design and may need to be altered after a test flight.

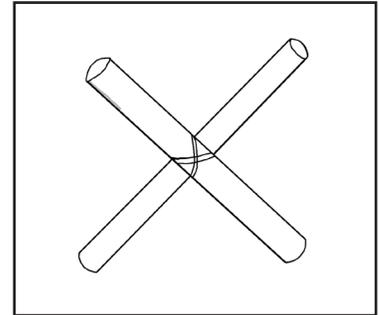


Fig. 1

How to Tie a Square Knot

1. Move the thread on the right side to the left, passing it under and through the thread on the left (see figure 2).
2. Repeat the action, but this time lead with the left side: move the thread on the left to the right, passing it under and over (see figure 3).
3. Pull both ends tightly to secure the knot.

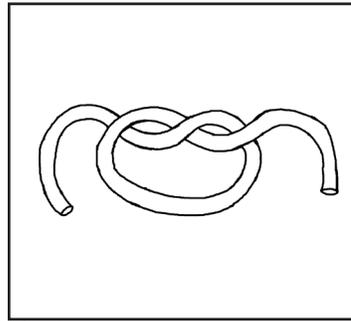


Fig. 2

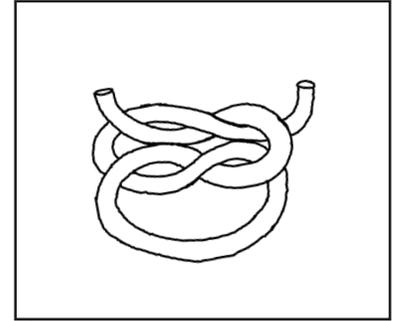


Fig. 3

11. Attach the kite tail.
12. Make a kite string handle. This can be done by using a dowel rod to attach two identical pieces of Creativity Steet Turnings. Cut a small piece of dowel rod, the length will be determined by the depth of the hole in the turnings. Apply hot glue to the opening of the turning and insert the dowel piece. Apply hot glue to the opening of the second turning and attach it to the exposed dowel rod.
14. Use a square knot to tie the Beadalon Dandyline Synthetic Beading Thread onto the center of the joined turnings. Wind approximately 20 to 30 feet of string around the handle.
15. Tie the kite string to the bridle.
16. Fly your kite! Adjustments to the bridle and/or tail may need to be made after the first test flight.

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National Core Arts Standards - Visual Arts

Creating

Anchor Standard 1: Generate and conceptualize artistic ideas and work.

Anchor Standard 2: Organize and develop artistic ideas and work.

Anchor Standard 3: Refine and complete artistic work

Presenting

Anchor Standard 5: Develop and refine artistic techniques and work for presentation.



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