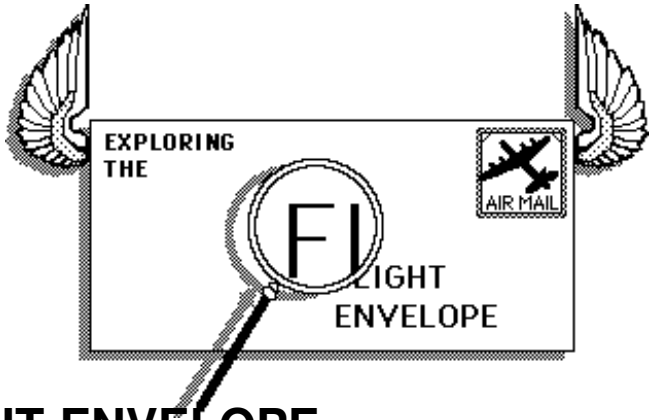


CHAPTER FOUR:

EXPLORING the FLIGHT ENVELOPE

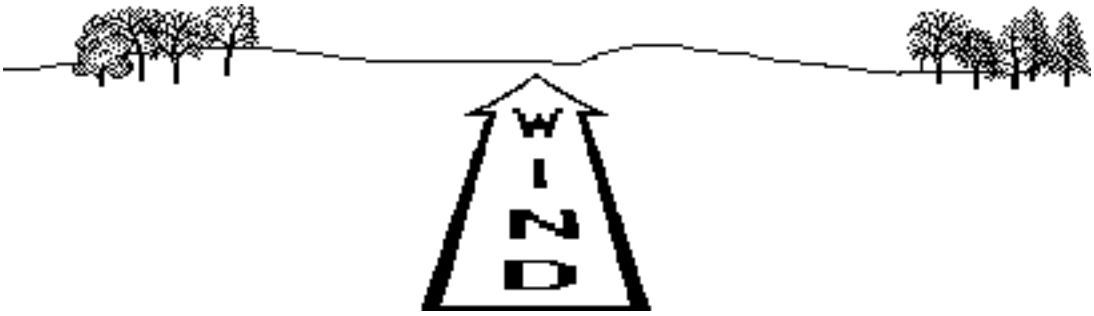
So what's a flight envelope? It's all the conditions under which a flying machine will fly. The conditions for an airplane include speed, altitude, throttle setting, weight, angle of attack, and many more. For a kite, the wind speed, tuning, line tension, control position, and so on are the conditions that allow flight. Think of the envelope as just that — an envelope. Inside the envelope are all the conditions that allow flight. Outside the envelope is everything else.

If you're "inside the flight envelope", you're flying. If you're "outside the envelope", you're not.

A rock doesn't fly (not enough lift).
An airplane in a stall doesn't fly (not enough speed, too much angle).
A kite in too little wind doesn't fly (not enough power).

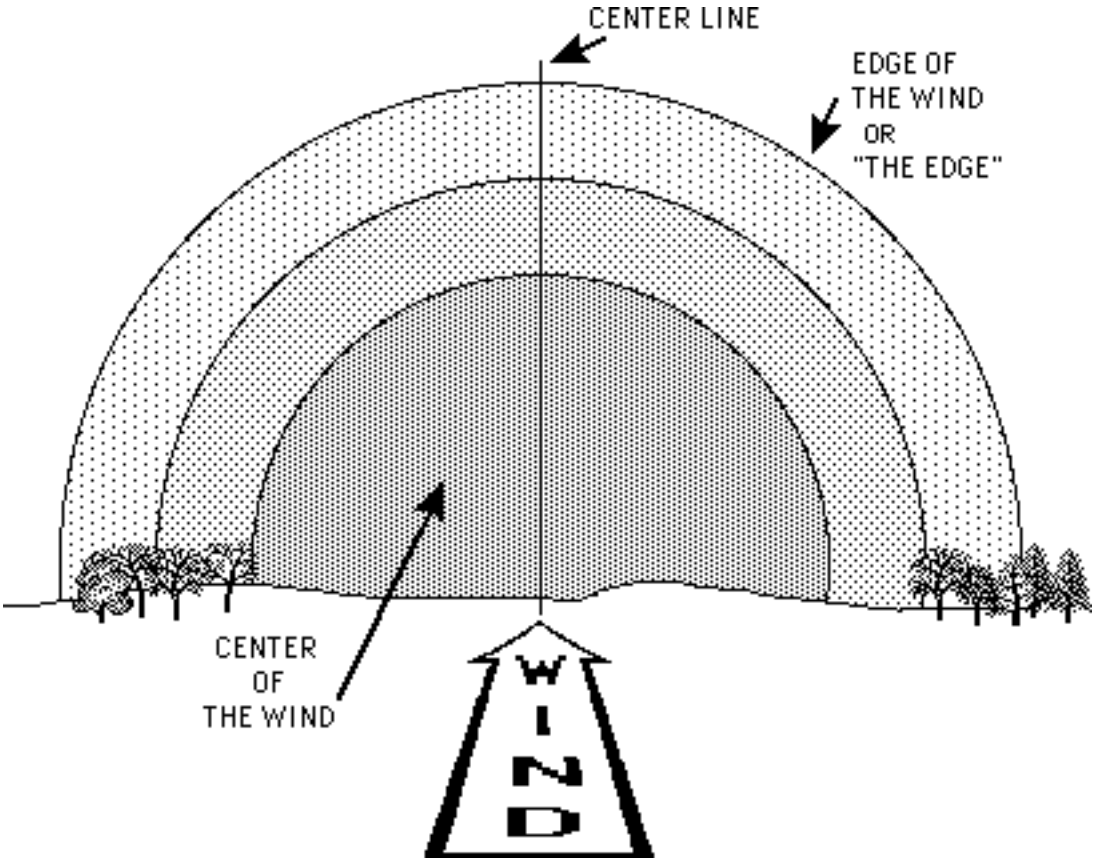
Inside the envelope there are many things to explore. In this section, we will look at the way the kite reacts to the wind, and the ways you can expect it to act under various conditions

Let's take a look at the wind from a new perspective:



When you fly, your kite is generally downwind. Sort of. But as you already know, it flies over a large area, and the wind affects the kite differently depending upon where it is in that area and which direction it's traveling.

Here's a new picture of your flying area:



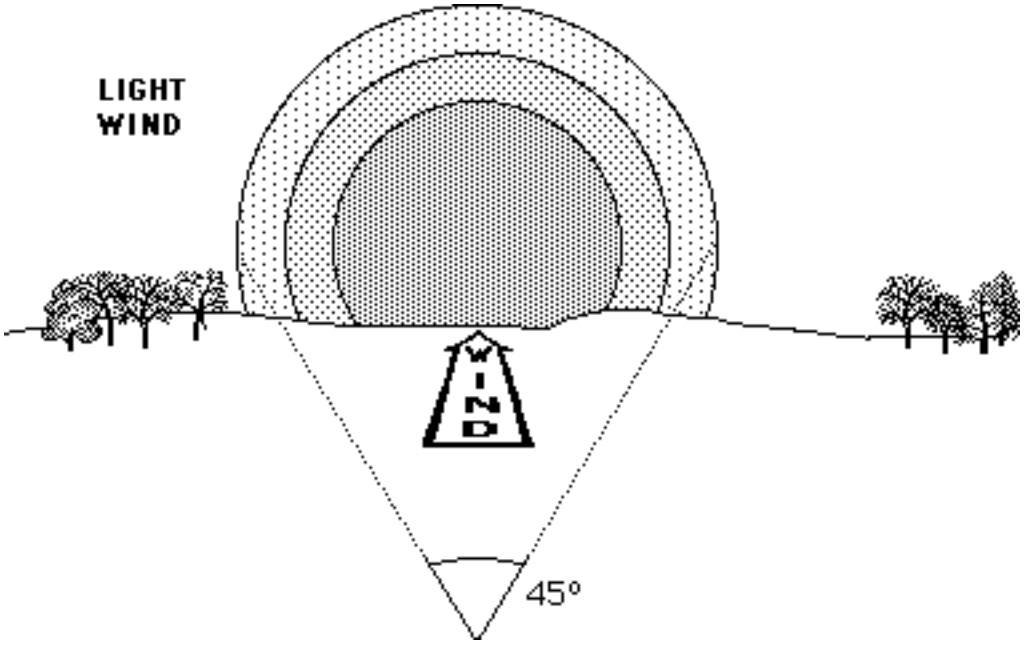
The CENTER LINE is an imaginary vertical line directly downwind. It's a handy reference, and something to keep in your mind as you fly.

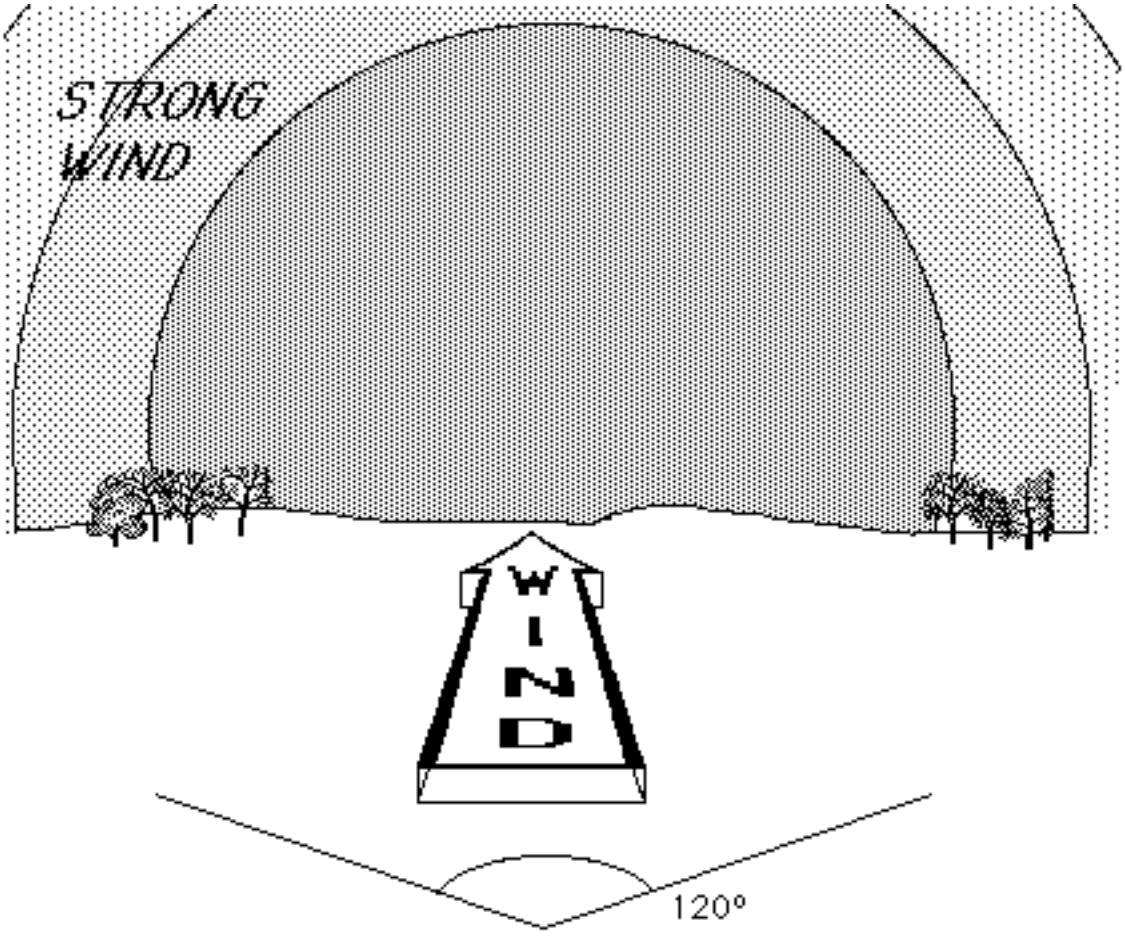
The CENTER OF THE WIND is the area in which the kite has good speed and maneuverability. You did your first maneuvers in the Center. The size of this area is not fixed, but varies depending on the strength of the wind, the state of the kite's tuning, and sometimes on local conditions. You'll soon learn the "feel" of the Center, and know when it grows and shrinks.

The EDGE OF THE WIND is the imaginary line in the sky that represents the farthest "out" to the left or right the kite will fly. Any time the kite is at the Edge, it has no forward drive. It will still fly, it just won't go anywhere. This condition is called a hover. We'll talk about hovering shortly. It's difficult to force the kite beyond the Edge. If you do, the kite will still be in the air, but it will be outside its flight envelope and not really flying.

Between the Center and the Edge, the kite will fly fine, but slower than in the Center. Its response to controls will be somewhat different than in the Center, too. The kite will have the characteristics you already know, combined with those we're going to talk about now.
Incidentally, it is helpful to remember that everything in the flying area grows and shrinks

in proportion depending on the strength of the wind. In strong wind, the kite will fly over an angle of 120 degrees or more. In light wind, the angle shrinks to as little as 45 degrees or even less. In all cases, the proportions of the various parts remain the same.



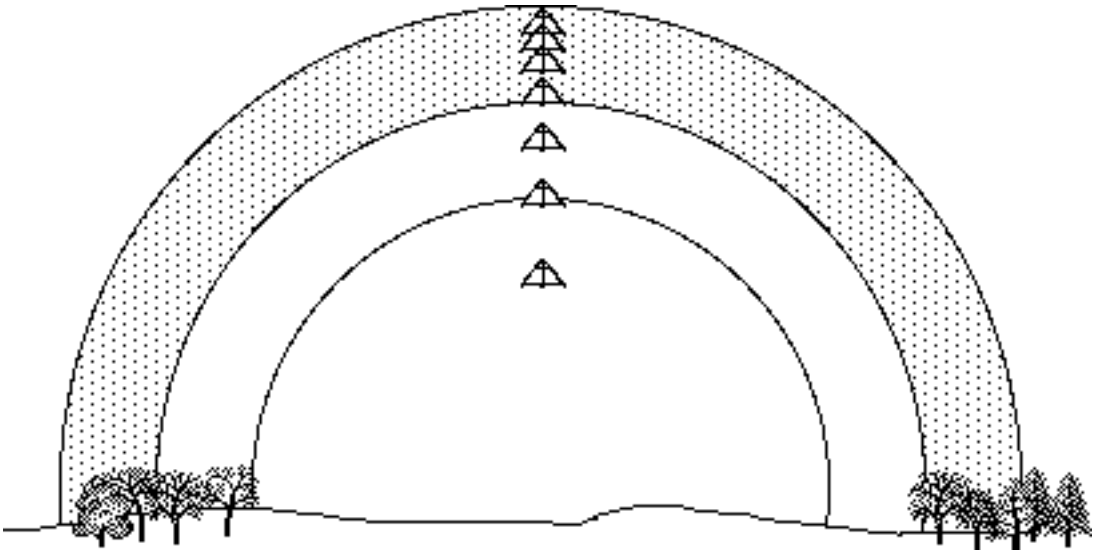


CONTROL RESPONSE AT THE EDGE

While doing beginning maneuvers, you stayed in the Center of the Wind. Steering was fairly straightforward. Pull left to turn left; pull right to turn right. If the kite strayed out towards the Edge, you probably brought it back quickly towards the Center. Now we'll go to the Edge deliberately, and take a look at what happens there.

(NOTE: It's much easier to do this the first time if the wind is 8 mph or stronger.)

Point the kite STRAIGHT UP. Hold your hands STILL and WAIT.



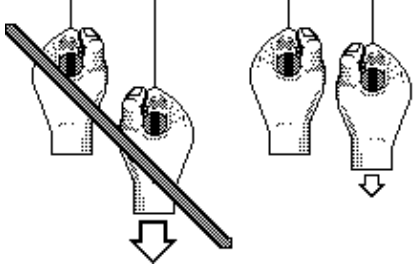
The kite will fly up, slow down, and stop! It's still flying. As a matter of fact, as far as the kite's concerned, it's still flying in a straight line. It doesn't know it's not going anywhere. This position is called a **HOVER**.

One very important thing has changed, however. The line pull has almost completely disappeared. There should only be as much line pull as the physical weight of the kite.

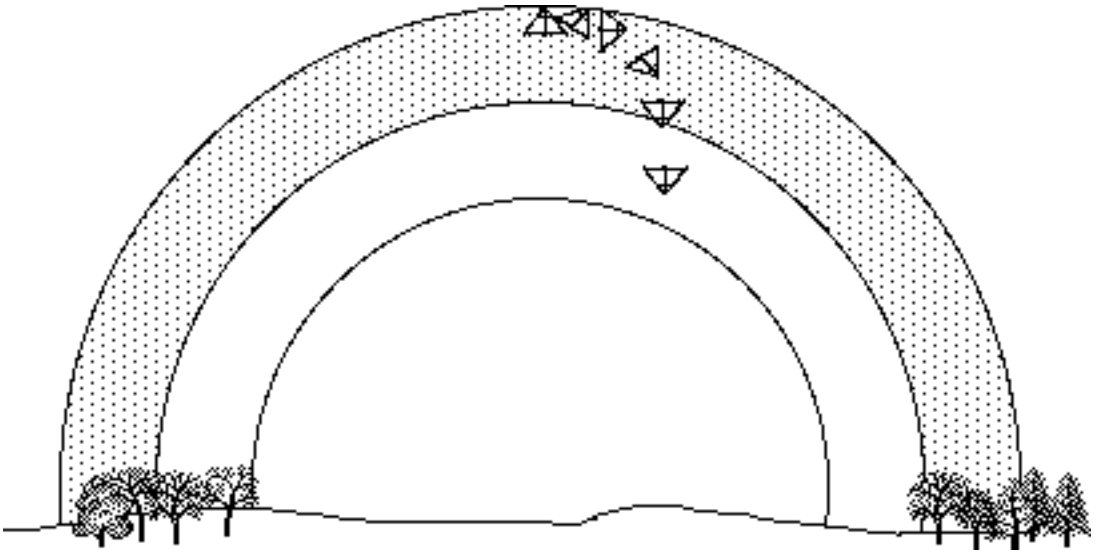
Hover for a little while, and notice the other important thing about flying near the Edge: YOUR CONTROL MOVEMENTS SHOULD BE MUCH SMALLER AND MORE SUBTLE.

If the kite starts to drift, just an ounce or two of pull will guide it back. Experiment with this, applying more, then less pull to turn the kite back and forth across the top of the sky.

Now turn out of the hover using a small control movement:
The kite will turn gracefully and gain speed as it flies towards the Center.



Also, the line pull will increase gradually as the kite's speed increases and it moves back towards the center.

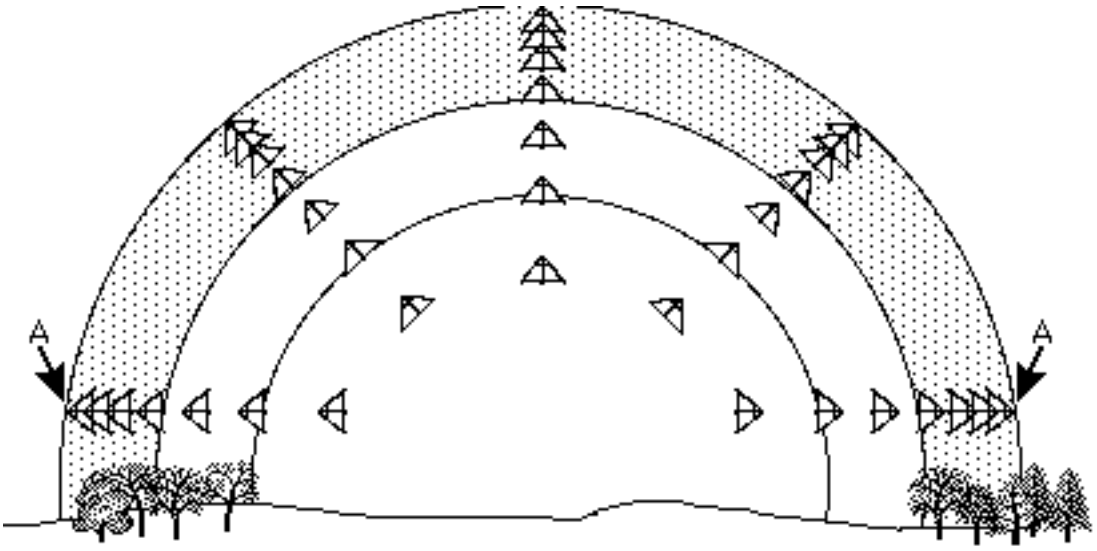


This has illustrated an important fact about control of your stunt kite: THE KITE IS PERFECTLY UNDER CONTROL EVEN IF THERE'S ALMOST NO PULL ON THE LINES ! !

Learn to apply that one fact, and you can make your kite do anything. Applying the right amount of control in the right situation will transform your flying. From just driving around the sky, you can learn to dance.

Now practice hovers everywhere (except close to trees):

When you do this, you'll discover two things:



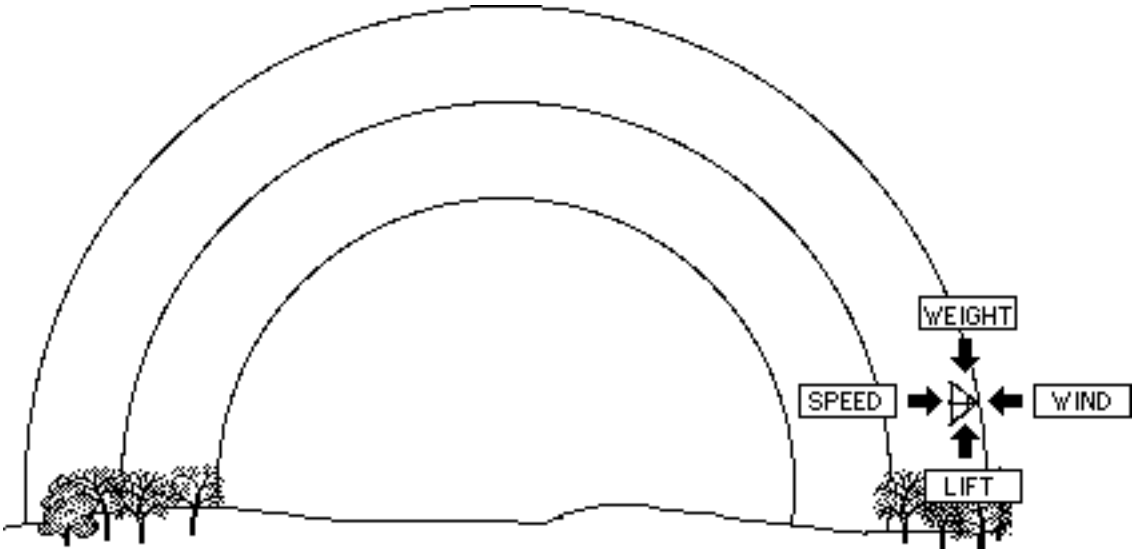
1. To do a hover with the kite pointed horizontally (like in the "A" points in the last illustration) you'll need to hold a little "up" line. If the kite is hovering to the right, you'll be holding a little up LEFT; if the kite is hovering to the left, you'll be holding

a little up RIGHT. This is because the kite must support its total physical weight. If you are flying a stack that weighs one pound, you'll have to hold one pound of extra pressure "up" on the line.

This actually happens any time you fly horizontally, but there is usually so much line tension that your hands don't notice the small difference. So it feels like "hold even to go straight", even though it's not strictly true.

2. Turning out of a horizontal hover to head back towards the center doesn't work quite the way you might expect. Here's how it works, and why:

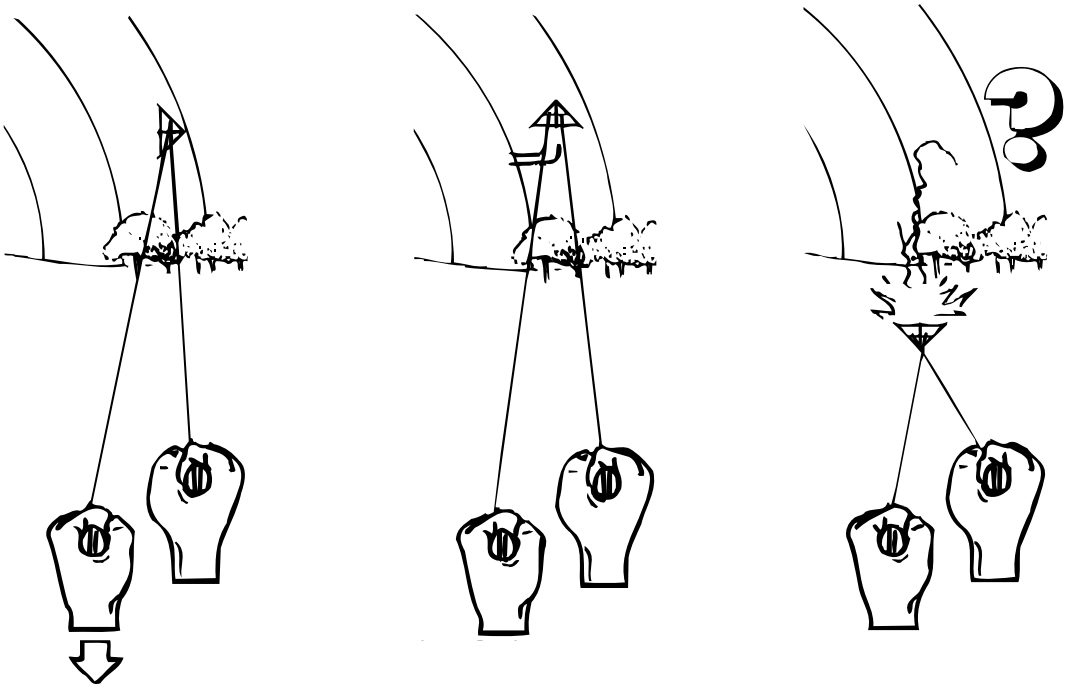
In a hover, everything is in equilibrium. The kite is flying at exactly the same speed as the wind, and is creating just enough lift to support its own weight. Fine, so far.



Now, turn out of the hover. Let's turn left, so the kite flies "up and over". Suddenly -- the kite stalls!

A Foil must be "arched" or "flexed" in order to fly. If the spar is flat rather than flexed, the kite is floating - not flying. In lighter winds, a Foil may have a tendency to float at the hover point. Be careful not to let it float "beyond the edge" and out of the envelope.

In order to complete a left turn, the kite had to climb. Climbing takes power, just as with an airplane. But remember, in a hover, everything is in equilibrium. The kite is flying at



YOU PULL LEFT - **THE KITE TURNS, STOPS, AND -** **FALLS OUT OF THE SKY.**

exactly the wind speed, and creating only enough lift to support its own weight. There's no extra power available. And that's why it stalls.

To avoid stalling, you need to ADD SOME POWER to help the kite to climb.

Remember the Better Normal Landing? You walked towards the kite in order to subtract your walking speed from the wind speed and reduce power for a shorter, softer landing. In this situation, you do the opposite.

One way you can add power is by taking a couple of steps backwards or upwind as you begin your turn. But the more polished technique is to pull back simultaneously with BOTH hands instead of just one.

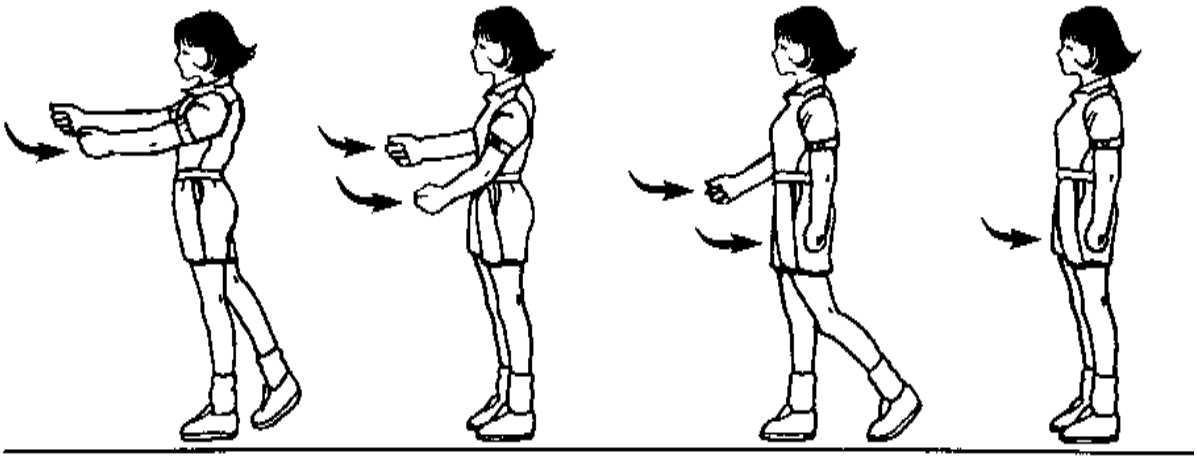
You may notice that going up and over to the right will "feel" like you're pulling harder with your left hand. What will really happen is that you'll pull with your left hand a fraction before pulling with your right, then bring your right hand even with your left a fraction after your left has completed its pull.

Don't worry, doing it isn't as complicated as explaining it!

Here's how it looks:

The left hand starts - then the right. Both hands pull. The right finishes even with the left.

Notice that the flyer pulls her hands DOWN past her thighs. This allows a longer pull than

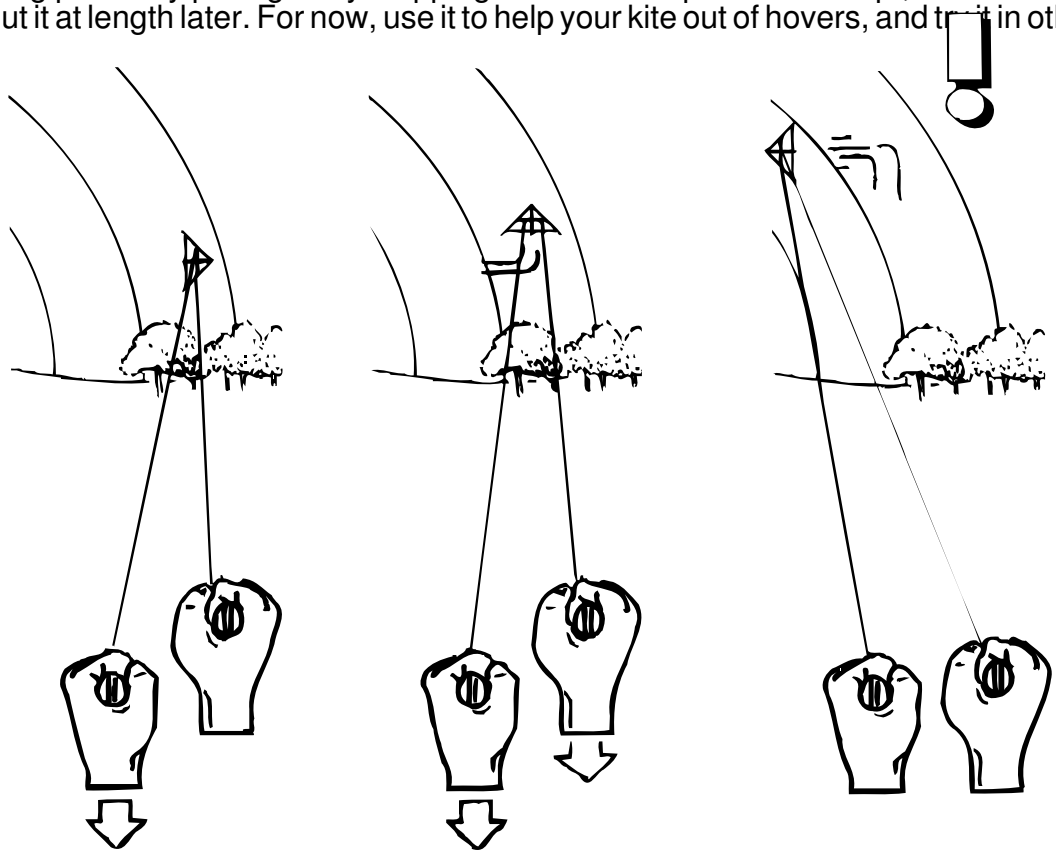


pulling back to her chest. Also, the weight of her arms helps the pull.

Also notice that a step backward increases speed and control. In fact, moving your feet is almost as important as moving your hands -- and is often more effective.

Here's the other view of the same maneuver:

Adding power by pulling or by stepping back is an important concept, and we'll talk about it at length later. For now, use it to help your kite out of hovers, and try it in other



YOU PULL LEFT - **THEN PULL BACK ON BOTH SIDES -** **AND OVER YOU GO.**

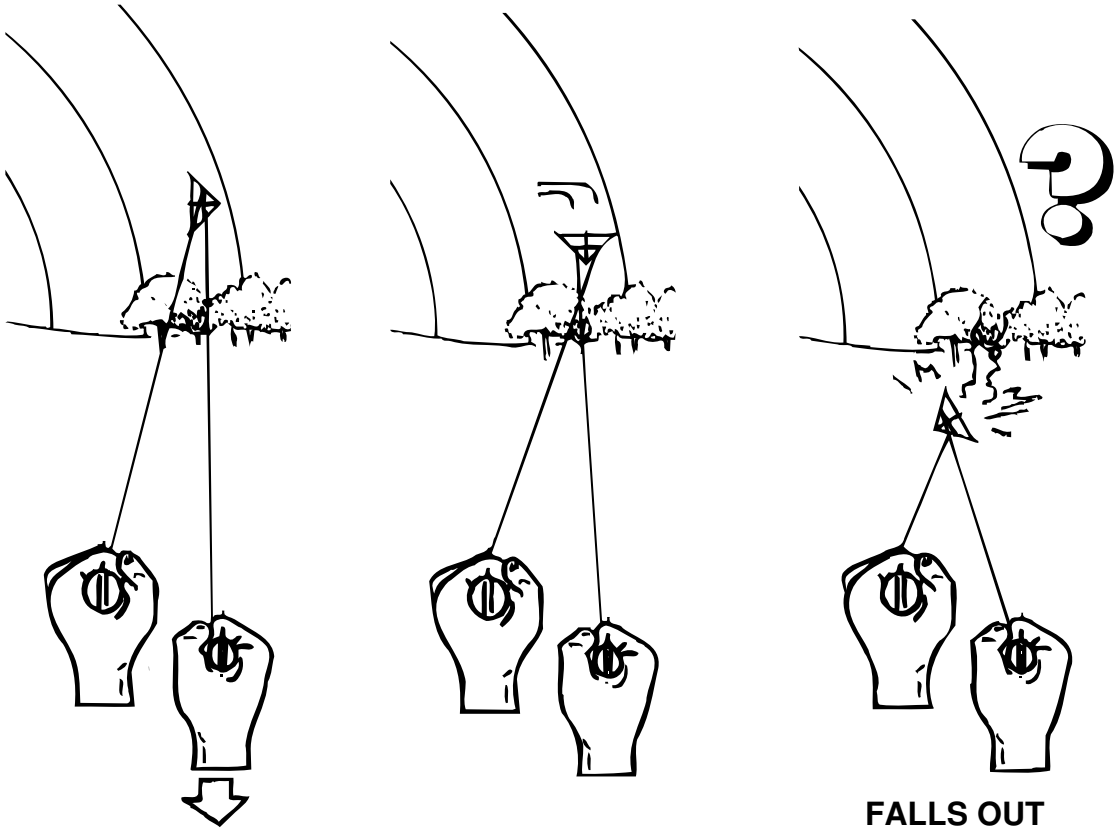
situations where your kite needs a little more power.

If you step back, remember to step forward to your original position again later. Pick a time when the kite has plenty of speed and pull, and walk up to where you were.

Otherwise, you may find yourself someplace you didn't plan to be!

Now let's turn right from the same hover and go "under". Remember to start with plenty of altitude at first, say 25 feet. Here's what may happen:

Now what?! Remember that it's possible to overcontrol. And remember that, the less line is pulling, the less control is required to achieve the same result. When the kite is



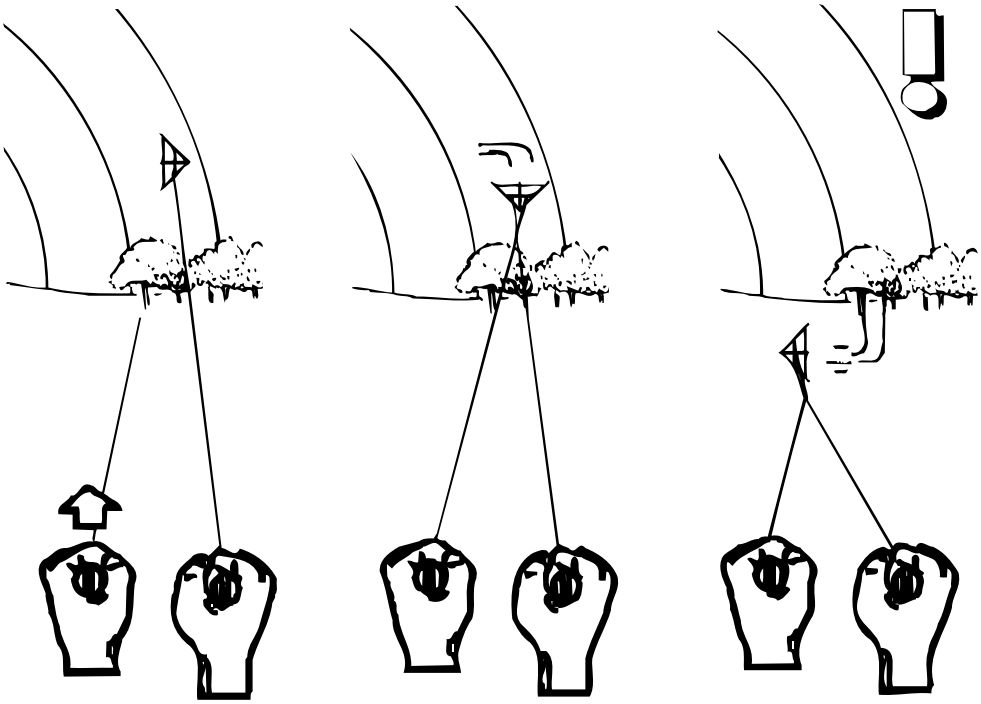
YOU PULL RIGHT - **THE KITE MAKES A WIDE SKIDDING TURN -** **FALLS OUT OF THE SKY.**

in equilibrium at a hover, and you PULL RIGHT, you've overcontrolled!

So how do you turn right? PUSH LEFT! That's right, push left. You're holding a little more tension on the left line in order to hold the hover (balancing the weight of the kite, remember?). So relax some of that extra tension, and the result is a nice, neat right turn.

While you are making this turn, there will be almost NO line tension. Finesse is important. Hold your right hand still. This will give the kite a "pivot point" and allow it to maintain stability. Push left just a little, and then HOLD THAT POSITION. It won't "feel" like you're accomplishing anything, but the kite knows what to do.

After you've tried this with plenty of altitude, try starting lower and lower until you're "tucking under" with only inches to spare. It's a sure "gasp getter" if anyone's watching!



PUSH WITH YOUR LEFT HAND -

THE KITE WILL PIVOT AROUND THE RIGHT LINE -

AND COMPLETE A GREAT MANEUVER.

AND NOW YOU'RE READY to go exploring. Try anything and everything you can think of, anywhere in the sky that the kite will go. You'll find other situations where you'll want to add power, and also where you'll want to "push" a turn. We'll talk about specific applications of these techniques later. For now, you have all the tools you need to thoroughly investigate the flight envelope, and to make your flying a completely enjoyable experience.

HAVE FUN !

Thrust and lift are the forces that enable a kite to defy gravity. Thrust is created by the velocity of the wind and the kite's speed. Lift is created when bridle and bridle tuning hold the kite at an appropriate angle into the wind.

The correct "angle of attack" causes air to move more slowly across the face of the kite and push upward. At the same time, air moving more quickly across the back of the kite reduces pressure creating a partial vacuum and additional lift.

Drag pulls back on a kite and gravity pulls downward . Gravity is determined by the weight of the kite; drag by its design and the flying angle set by the bridle. Simply put, ***a kite must have more lift than drag and gravity to fly****. However, some drag is necessary to give a kite stability. For instance, drag will actually slow a kite down in a dive.*