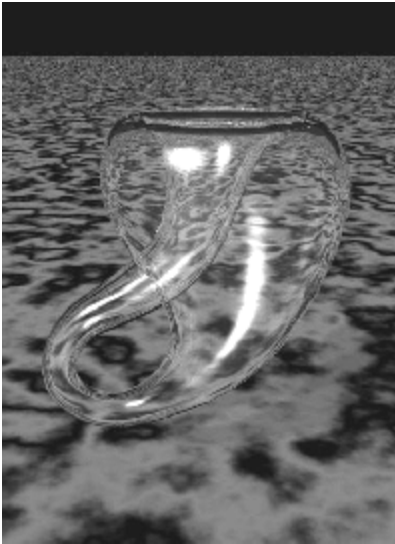
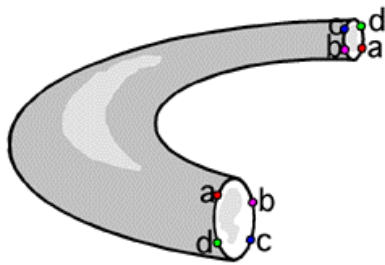


The Klein Bottle and Ushiro Ryokata Dori Kokyo Ho

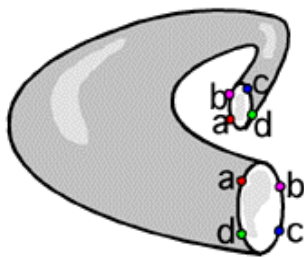


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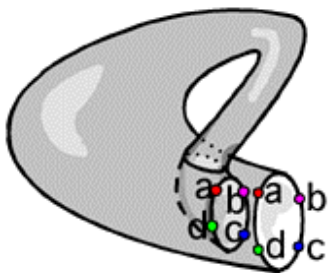
Michael Smith
Aikido of Monterey
April 1998



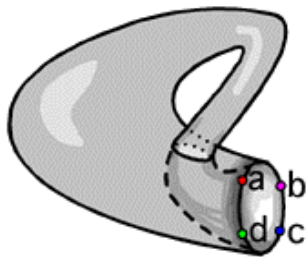
The Klein Bottle is a basic example of a closed, non-orientable surface. A Klein bottle is a tube that twists through four-dimensional space to connect to the "inside" of itself without actually making a hole. The accompanying image is not a true picture of a Klein bottle, since it depicts a self-intersection that isn't really there.



A Klein bottle can be constructed by gluing together the two long sides of a rectangle, forming a cylindrical tube, and then joining the two ends of the tube with a twist. The 180-degree twist imparts the left and right edges of the tube with opposite orientation, as in the formation of a Möbius band. The gluing instructions also tell us to glue all four corners of the rectangle into a single point. This can not be realized physically in 3-dimensional space. The fourth dimension - time - is essential. In 4-dimensional space, the Klein bottle is realized by projecting one end of the tube in the direction of the 4-th coordinate axis, just as it is about to pass through near the other end of the tube, then dropping it back into 3-dimensional space inside the other end of the tube. Another way to make a Klein bottle is to take two Möbius bands and join them along their boundaries (each band has a single boundary curve).



The Klein bottle has no boundary - it is a **closed** surface with no interior and only one surface. An object moving on the surface of a Klein bottle never encounters any barriers to its motion. Most containers, whether spheres or cylinders or boxes, have an inside and an outside but the Klein Bottle has only one side - it can not hold any liquid.



It is **non-orientable**, which means that it contains a path for which it is impossible to define a left- and right-hand side in a consistent global way. In a Kleinian universe, an object moving across the surface in the untwisted direction, returns to its starting point still moving in the same direction. However, if it moves in the twisted direction, it comes back with its position, momentum and handedness flipped.



Ushiro Ryokata Dori Kokyo Ho

is an Aikido technique, the general outline of which is reminiscent of a Klein bottle. Being an Aikido technique it involves joining, spirals, and continuity of flow.

In performing this technique, nage pivots toward uke making a complete turn, passing the head and "outside" arm through the opening between uke's arms, then completing the throw by rotating the hips back in the opposite direction.

As the tube of the Klein Bottle connects to itself without making a hole, so does this movement express the ideals of *no opening*, as well as that of not breaking or destroying. The fabric of Harmony is maintained and reaffirmed.



The construction of a Klein Bottle involves joining the 4 corners of rectangle into a single point: or, in the philosophy of Aikido, bringing the "4 corners of the earth" together ... "all human beings as one family". Expressed in another way, it is the joining of two bands (Möbius, tribes, belief systems, etc.) together along their boundary, thus revealing the illusion of separation and the true one-ness of everything.



Instead of intersecting itself the tube of the Klein Bottle is projected in the direction of the 4-th coordinate axis. Likewise, at the point at which atemi could be used to injure or kill, we instead pass through - the decision and the movement both occurring on and reflecting a different plane than that of conflict, struggle, destruction, and unbending forms of thinking.

As an object moving on the surface of a Klein bottle never encounters any barriers to its motion, ideally both uke and nage move in harmony - where neither encounters anything to interrupt the flow of energy. There is no boundary of fist striking bone or the



wrenching of parts out of alignment. Rather we move in spirals, and thus without boundaries.

Ushiro Ryokata Dori Kokyo Ho illustrates a non-orientable surface. In passing through the cycle of the movement, the energy of uke's attack (position, momentum) is "flipped" into the realm of ukemi. We do not project left or right, right or wrong, good or bad - we strive to follow the Way without judgement or bias.



We use ordinary containers to separate the contents from the outside. The Klein Bottle, the un-ordinary container, separates nothing, while transforming all that moves upon its surface. In traditional martial arts the process of self-defense was based upon separating oneself from the source of conflict by eliminating or destroying it. In Aikido, in the philosophy of O'Sensei, we believe in our responsibility to "lovingly protect" all creation; that another individual cannot be separated from ourselves, nor ourselves from the rest of the universe.

Freed from the constraints of a purely technical interpretation, the language of theoretical mathematics thus reveals a closer kinship with the physical and philosophical expressions of Aikido than at first might be supposed.

Feel free to move beyond the boundaries of your perception.