

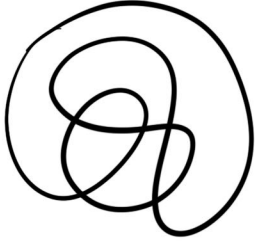
How to Draw Knots Bounding surfaces



Draw a knot!

step 1: Loop

Draw loop w/o picking up pencil (start & end at same point)



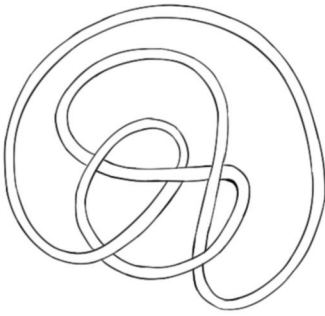
step 2: Crossings

choose over/under strands at each crossing



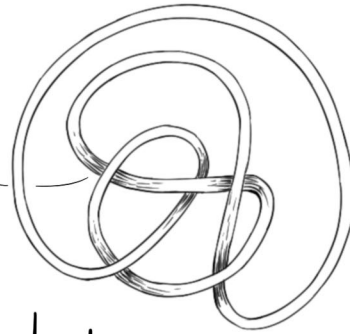
Fun Fact: you can always weave a curve, alternating over/under crossings while drawing the knot.

Step 3: thicken

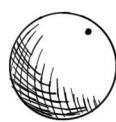


step 4: shade crossings

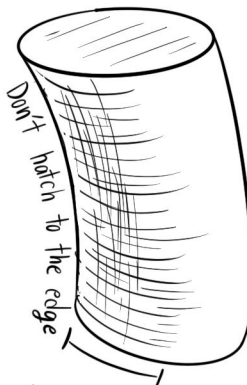
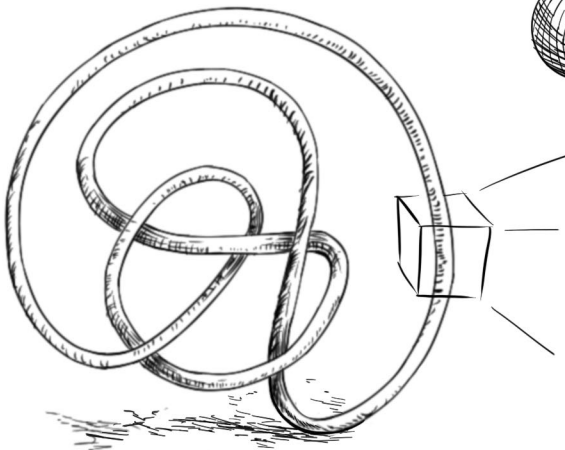
hatch parallel to curve



Step 5: Shade!



lighting reference: a shaded sphere

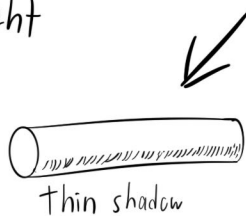
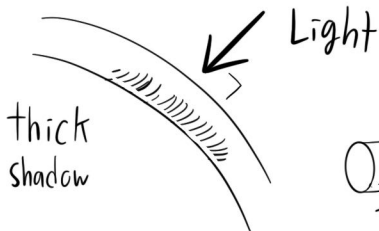


Shaded area \propto dot product w/ light vector

Hatch along ellipses tangent to boundary. Ellipses are orthogonal crosssections to the knot tube



Hatches are \perp to boundary only when knot is pointing \perp to you. This happens at maximal/minimal distance of knot from plane.



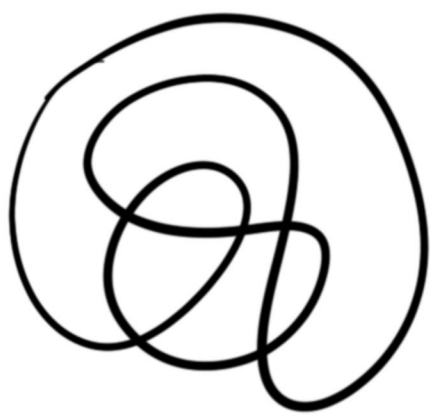
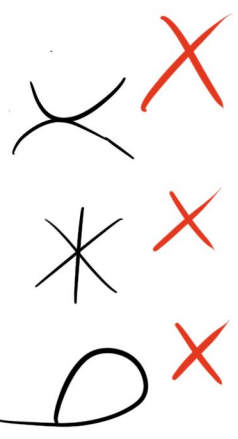
A soapy surface:

1: Draw a loop:

no tangencies

no triple points

start & end @ same point

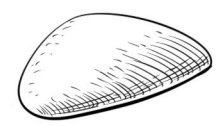


2. shade every other region

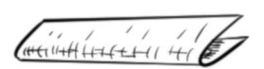
3. choose crossings

The concavity of a fold is determined by the gaussian curvature

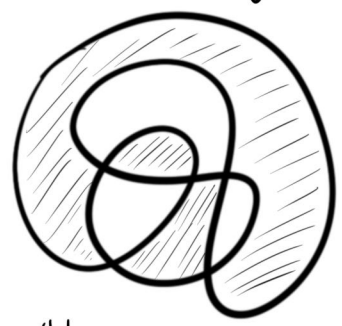
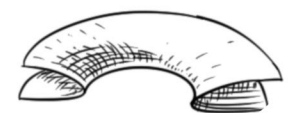
convex fold ↔ Positive curvature



straight fold ↔ zero curvature



concave fold ↔ negative curvature



Always possible!

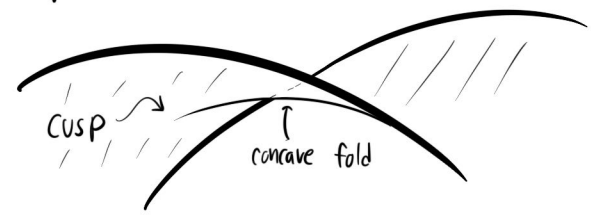
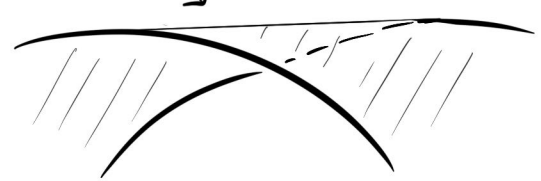
4. Draw crossing as Twist

Choose your material!!

Paper: zero gaussian curvature

Soap: negative gaussian curvature

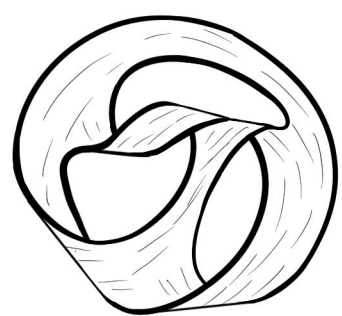
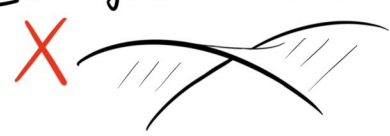
fold line tangent to curve



! may need to rearrange knot to allow tangent lines

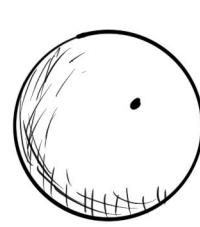
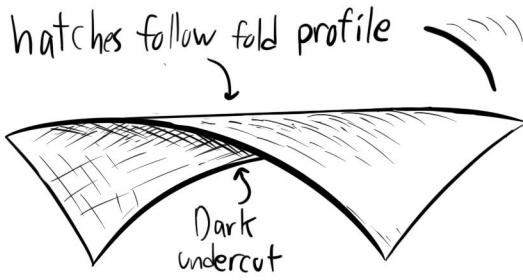
! fold goes on "inside"

! include the cusp!

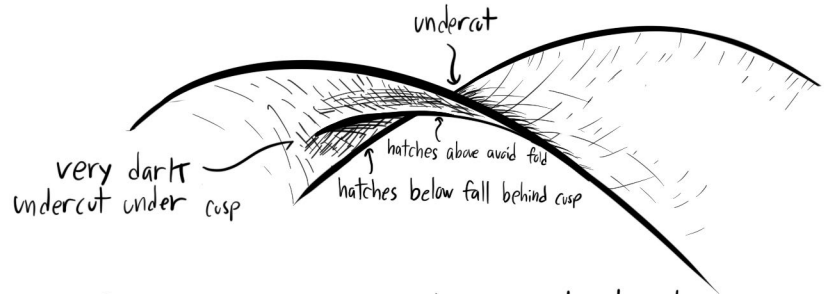


5. Shade twists

Paper:



Soap:

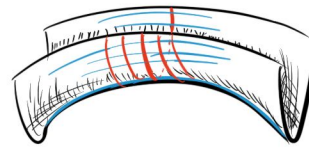


- Darkness indicates Depth. if one sheet on front of another, shade back sheet near overlap.

↳ shade the area behind a cusp especially dark. (cusps are important)

- Crosshatching establishes a coordinate grid on surface. conform this to the geometry. I crosshatch along lines of principal curvature

↳ hatches are tangent to folds, but pass transversally behind cusps.



Along a fold, lines of principal curvature are parallel to the fold (Blue) and its crosssection (Red)

Shade each crossing and interpolate to shade your surface!

