APPLIED MATHEMATICS LABORATORY

3D SURFACE PREP

Beginning with a 4 inch by 4 inch cardboard square, glue on the grid with 3.2 cm unit spacing.
On the underside of the cardboard square, tape a pipecleaner under each grid unit mark.
There are two options for this: two pipecleaners per side (at the 1 and 2 unit marks) or four pipecleaners per side (at the 0, 1, 2, and 3 unit marks).
Cut full-length pipecleaners into eighths for the short twist-tie pipecleaner pieces.

Tips for the activity process: In step 3, running your pipecleaner through your fingers and pinching at sharp corners can also help it hold the shape of the surface.
Between steps 3 and 4, tape one of the sets of pipecleaners down where it meets the cardboard, leaving the other set of pipecleaners (those attached to the other edge of the cardboard) free so the form can still slide out in step 5. This can help hold the model steadier as you twist-tie the pipecleaners at the intersections.
In step 4, you might want to begin to twist-tie at the corner where both cardboard edges already have pipecleaners attached.

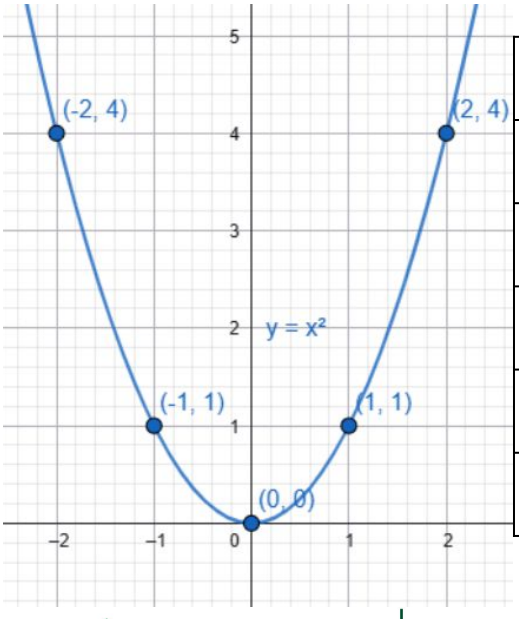
Cal Poly Pomona
College of Science
MATHEMATICS & STATISTICS

APPLIED MATHEMATICS LABORATORY

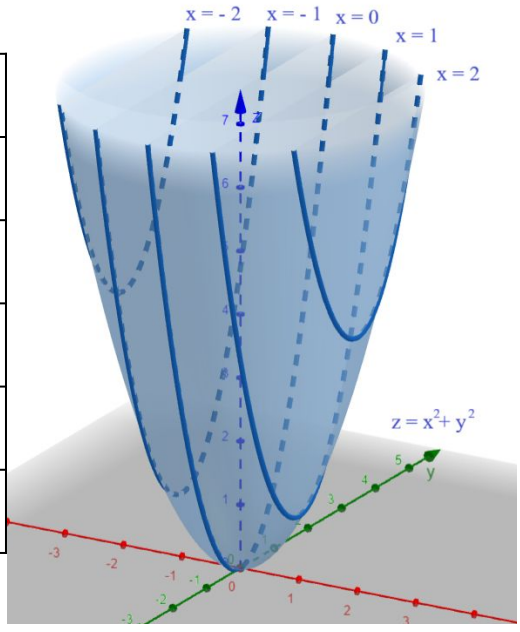
3D SURFACE TRACES

When we have an equation with two variables, we can graph it on a Cartesian plane, where the first variable is graphed on the x-axis and the second variable is graphed on the y-axis. This gives us a curve.
When we have an equation with three variables, we can graph it on a Cartesian plane that has three axes. This gives us a surface.

A helpful way to understand the shape of a curve or surface is to choose values for one of the variables and look at the equation for those values. The result is an equation with one less dimension, a one-dimensional point or a two-dimensional trace. By looking at several points or traces, we can gain a good sense of what the shape of the curve or surface is.



Point	x	Trace
$y = 4$	2	$z = y^2 + 4$
$y = 1$	1	$z = y^2 + 1$
$y = 0$	0	$z = y^2$
$y = 1$	-1	$z = y^2 + 1$
$y = 4$	-2	$z = y^2 + 4$



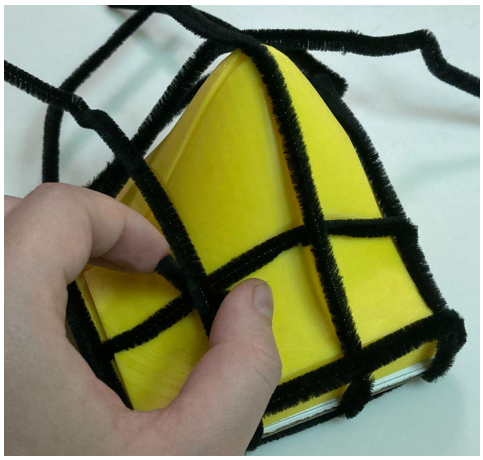
Images: geogebra.org

Cal Poly Pomona
College of Science
MATHEMATICS & STATISTICS

APPLIED MATHEMATICS LABORATORY

3D SURFACE ACTIVITY

STEP 1 Choose a 3D surface form and write its equation on your cardboard square.



STEP 2 Place the cardboard square grid-side-up and tape-side-down. Place your form on the cardboard grid so the tallest side is not on a pipecleaner side of the grid.

STEP 3 Press each pipecleaner into its grove along the surface. When you reach the cardboard, pinch the pipecleaner to mark the spot.

STEP 4 Use the short pipecleaner pieces to twist-tie the long pipecleaners together at each point where their groves in the surface meet. Leave the pipecleaner along one of the taller sides of the form unattached.

STEP 5 Slide the form out on the tallest side.

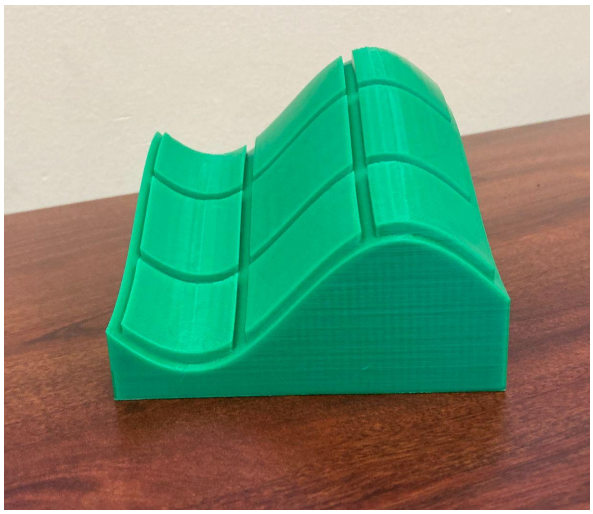
STEP 6 Using the pinch-marks to tell where your pipecleaners should meet the cardboard, tape the pipecleaners on the bottom of the cardboard square.

You are done! Enjoy and observe the shapes of the traces of your 3D surface.

Cal Poly Pomona
College of Science
MATHEMATICS & STATISTICS

APPLIED MATHEMATICS LABORATORY

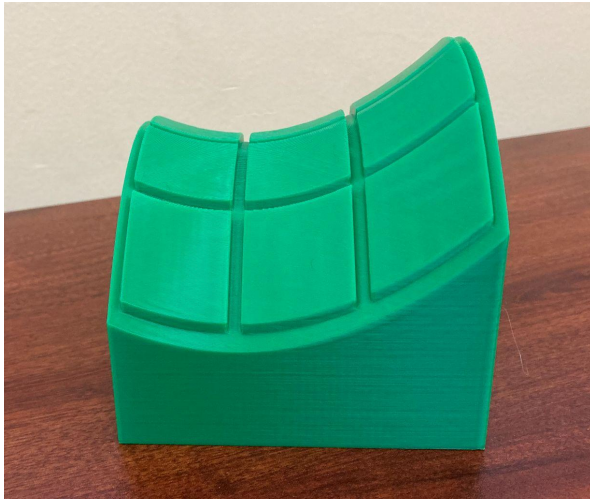
3D SURFACES



$$z = \frac{1}{3}(\sin(2x) + \cos(y) + 2)$$

$$z = \frac{1}{3}\left(\frac{x\,y^2}{9} + 1\right)$$

$$z = \frac{2}{3}\, e^{\frac{-(x-2)^2-(y-1)^2}{2}} + 0.5$$



$$z = \frac{1}{3}\left(\frac{-(x-1)^2+(y-2)^2}{2} + 2\right)$$

Cal Poly Pomona

College of Science
MATHEMATICS & STATISTICS