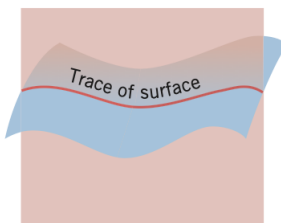
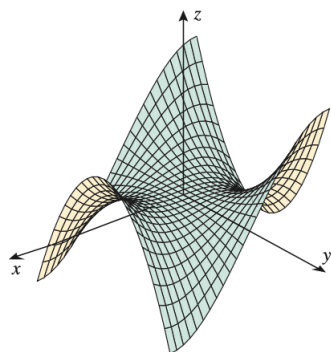


Meshes help us see the shape of a surface when it's graphed. A single mesh line is called a **trace**.



A **quadric surface** is a surface that is described by a quadratic equation in  $x$ ,  $y$  and  $z$ :

$$Ax^2 + By^2 + Cz^2 + Dxy + Eyz + Fxz + Gx + Hy + Iz + J = 0.$$

We'll mostly focus on quadric surfaces without mixed terms, e.g.  $x^2 + y^2 - z^2 = 1$  or  $x = y^2 - z^2$ .

## Types of Quadric Surfaces

Surface	Equation	Surface	Equation
<b>Ellipsoid</b> 	$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ <p>All traces are ellipses. If <math>a = b = c</math>, the ellipsoid is a sphere.</p>	<b>Cone</b> 	$\frac{z^2}{c^2} = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ <p>Horizontal traces are ellipses. Vertical traces in the planes <math>x = k</math> and <math>y = k</math> are hyperbolas if <math>k \neq 0</math> but are pairs of lines if <math>k = 0</math>.</p>
<b>Elliptic Paraboloid</b> 	$\frac{z}{c} = \frac{x^2}{a^2} + \frac{y^2}{b^2}$ <p>Horizontal traces are ellipses. Vertical traces are parabolas. The variable raised to the first power indicates the axis of the paraboloid.</p>	<b>Hyperboloid of One Sheet</b> 	$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$ <p>Horizontal traces are ellipses. Vertical traces are hyperbolas. The axis of symmetry corresponds to the variable whose coefficient is negative.</p>
<b>Hyperbolic Paraboloid</b> 	$\frac{z}{c} = \frac{x^2}{a^2} - \frac{y^2}{b^2}$ <p>Horizontal traces are hyperbolas. Vertical traces are parabolas. The case where <math>c &lt; 0</math> is illustrated.</p>	<b>Hyperboloid of Two Sheets</b> 	$-\frac{x^2}{a^2} - \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ <p>Horizontal traces in <math>z = k</math> are ellipses if <math>k &gt; c</math> or <math>k &lt; -c</math>. Vertical traces are hyperbolas. The two minus signs indicate two sheets.</p>