TRACES. To draw surfaces, it helps to look at the \textit{traces}, the intersections of the surfaces with the coordinate planes $x = 0, y = 0$ or $z = 0$.

\textbf{Quadrics:} If $f(x, y, z) = ax^2 + by^2 + cz^2 + dxy + exz + fyz + gx + hy + kz + m$ then the surface $f(x, y, z) = 0$ is called a \textit{quadric}. Below are some examples.

\textbf{SPHERE.}
All three traces are circles

\[
(x - a)^2 + (y - b)^2 + (z - c)^2 = r^2
\]

\textbf{PARABOLOID.}
The $z$-traces are circles, the $x$ and $y$ traces are parabolas.

\[
(x - a)^2 + (y - b)^2 - c = z
\]

\textbf{PLANE.}
All three traces are lines.

\[
ax + by + cz = d
\]

\textbf{ONE SHEETED HYPERBOLOID.}
The $z$-traces are circles, the $x$ and $y$ traces are hyperbolas.

\[
(x - a)^2 + (y - b)^2 - (z - c)^2 = r^2
\]
CYLINDER. 
The z-traces are circles, the x and y traces are lines.

\[(x - a)^2 + (y - b)^2 = r^2\]

TWO SHEETED HYPERBOLOID. 
The z-traces are circles or empty, the x and y traces are hyperbolas.

\[(x - a)^2 + (y - b)^2 - (z - c)^2 = -r^2\]

ELLIPSOID. 
All three traces are ellipses.

\[\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1\]

HYPERBOLID PARABOLOID. 
The z-trace form two crossed lines, the x- and y- traces are parabolas.

\[x^2 - y^2 + z = 1\]

TWO SHEETED ELLIPTIC HYPERBOLOID. 
The z-traces are ellipses or empty, the x and y traces are hyperbolas.

\[\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = -r^2\]