Figure 1: A point $P$ lies on $\mathcal{P}$ if $\overrightarrow{P_0P} \perp \mathbf{n}$. 
FIGURE 2 The plane with normal vector $\mathbf{n} = \langle 0, 0, 3 \rangle$ passing through $P_0 = (1, 2, 0)$ is the $xy$-plane.
**THEOREM 1** Equation of a Plane

Plane through $P_0 = (x_0, y_0, z_0)$ with normal vector $\mathbf{n} = \langle a, b, c \rangle$:

**Vector form:**

$$\mathbf{n} \cdot \langle x, y, z \rangle = d$$

**Scalar forms:**

$$a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$$

$$ax + by + cz = d$$

where $d = \mathbf{n} \cdot \langle x_0, y_0, z_0 \rangle = ax_0 + by_0 + cz_0$.

**Example.** Show that any two points $P$ and $Q$ on the plane $6x - 3y + 2z = 12$, the vector $\overrightarrow{PQ}$ is perpendicular to the vector $\langle 6, -3, 2 \rangle$. 
Parallel planes

**FIGURE 4** Parallel planes with normal vector \( \mathbf{n} = \langle 7, -4, 2 \rangle \).
Example. Find the equation of the plane determined by the three points $(5, 1, 1)$, $(1, 1, 2)$, and $(2, 1, 1)$. 

**Example.** Find the equation of the plane determined by the three points $(5, 1, 1)$, $(1, 1, 2)$, and $(2, 1, 1)$. 

**Figure 5** Three points $P$, $Q$, and $R$ determine a plane (assuming they do not lie in a straight line).
Trace of a plane

**Figure 6** The three blue lines are the traces of the plane \(-2x + 3y + z = 6\) in the coordinate planes.