The direction of the $z$-axis is determined by the right-hand rule: If you curl the fingers of your right hand around the $z$-axis in the direction of a $90^\circ$ counterclockwise rotation from the positive $x$-axis to the positive $y$-axis, then your thumb points in the positive direction of the $z$-axis.

The three coordinate planes divide space into eight parts, called octants. The first octant is determined by the positive axes (i.e., $x \geq 0, y \geq 0, z \geq 0$).

If we drop a perpendicular from $P(a, b, c)$ to the $xy$-plane, we get a point $Q$ with coordinates $(a, b, 0)$ called the projection of $P$ on the $xy$-plane. Similarly, $R(0, b, c)$ is the projection of $P$ on the $yz$-plane and $S(a, 0, c)$ is the projection of $P$ on the $xz$-plane.

$\mathbb{R}^3 = \{(x, y, z)|x, y, z \in \mathbb{R}\}$ is called a three-dimensional rectangular coordinate system.

**Distance Formula in Three Dimensions** The distance $|P_1P_2|$ between the points $P_1(x_1, y_1, z_1)$ and $P_2(x_2, y_2, z_2)$ is

$$|P_1P_2| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}.$$

**Equation of a Sphere** An equation of a sphere with center $C(h, k, l)$ and radius $r$ is

$$(x - h)^2 + (y - k)^2 + (z - l)^2 = r^2.$$