Ellipses with Center at the Origin

	Horizontal Major Axis	Vertical Major Axis
Graph	Figure 9.2.4	Figure 9.2.5
	Minor y $(0, b)$ Vertex $(a, 0)$ Center $(0, 0)$ $(c, 0)$ Focus Focus x Vertex $(-a, 0)$ $(0, -b)$ Major axis	Focus $(0, c)$ Vertex $(0, a)$ $(-b, 0)$ Center $(0, 0)$ Minor axis $(b, 0)$ x Focus $(0, -c)$ Vertex $(0, -a)$
Equation	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, a > b > 0$	$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1, a > b > 0$
Center	(0, 0)	(0, 0)
Foci	$(-c, 0), (c, 0), c = \sqrt{a^2 - b^2}$	$(0,-c), (0,c), c = \sqrt{a^2 - b^2}$
Vertices	(-a, 0), (a, 0)	(0,-a),(0,a)
Major axis	Segment of x-axis from $(-a, 0)$ to $(a, 0)$	Segment of <i>y</i> -axis from $(0, -a)$ to $(0, a)$
Minor axis	Segment of y-axis from $(0, -b)$ to $(0, b)$	Segment of x-axis from $(-b, 0)$ to $(b, 0)$

Ellipses with Center at (h, k)

	Horizontal Major Axis	Vertical Major Axis	
Graph	Figure 9.2.9	Figure 9.2.10	
	Minor Vertex $(h+a, k)$ $(h-c, k) \qquad (h+c, k)$ Focus $(h, k-b)$ Major $(h-a, k)$ axis	Vertex Focus $(h, k+a)$ $(h, k+c)$ $(h+b, k)$ Minor axis $(h-b, k)$ Vertex $(h, k-c)$ $(h, k-c)$ $(h, k-c)$	
Equation	$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1, a > b > 0$	$\frac{(x-h)^2}{b^2} + \frac{(y-k)^2}{a^2} = 1, a > b > 0$	
Center	(h, k)	(h, k)	
Foci	$(h-c, k), (h+c, k), c = \sqrt{a^2 - b^2}$	$(h, k - c), (h, k + c), c = \sqrt{a^2 - b^2}$	
Vertices	(h-a,k),(h+a,k)	(h, k-a), (h, k+a)	
Major axis	Segment of the line $y = k$ from $(h - a, k)$ to $(h + a, k)$	Segment of the line $x = h$ from $(h, k - a)$ to $(h, k + a)$	
Minor axis	Segment of the line $x = h$ from $(h, k - b)$ to $(h, k + b)$	Segment of the line $y = k$ from $(h - b, k)$ to $(h + b, k)$	

Ellipse with a horizontal major axis:

Equation	$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$	
Center	(h, k)	
Foci	$(h-c, k), (h+c, k), c = \sqrt{a^2-b^2}$	
Vertices	(h-a,k) and $(h+a,k)$	
Major axis	Parallel to x-axis between $(h - a, k)$ and $(h + a, k)$	
Minor axis	Parallel to y-axis between $(h, k - b)$ and $(h, k + b)$	

If the center is at the origin, then (h, k) = (0, 0).

▶ Ellipse with a vertical major axis:

Equation	$\frac{(x-h)^2}{b^2} + \frac{(y-k)^2}{a^2} = 1$
Center	(h, k)
Foci	$(h, k - c), (h, k + c), c = \sqrt{a^2 - b^2}$
Vertices	(h, k-a) and $(h, k+a)$
Major axis	Parallel to y-axis between $(h, k - a)$ and $(h, k + a)$
Minor axis	Parallel to x-axis between $(h - b, k)$ and $(h + b, k)$

If the center is at the origin, then (h, k) = (0, 0).