Ellipses vs Hyperbolas (without worrying whether *a* or *b* goes under *x* or *y*)

The definitions, equations and properties for ellipses and hyperbolas are very similar but also very subtly different

[redacted]	**Ellipse**	**Hyperbola**
Basic equation when center at origin (use shifts when center not at origin)	$\frac{x^2}{m^2}+\frac{y^2}{n^2}=1$	$\frac{x^2}{m^2}-\frac{y^2}{n^2}=1$ if hyperbola opens horizontally (coefficient of x^2 positive) $\frac{y^2}{n^2}-\frac{x^2}{m^2}=1$ if hyperbola opens vertically (coefficient of y^2 positive)
[redacted]	To find the number under x^2, start at the center of the ellipse or hyperbola, and move horizontally until you hit a point on the conic. Square that distance.	To find the number under y^2, start at the center of the ellipse or hyperbola, and move vertically until you hit a point on the conic. Square that distance.
	For a hyperbola, only one of the two above methods will work (*) (for the "positive" variable – that does not have the subtraction in front of it), since you won't hit the hyperbola if you move in the other direction.	
Distances from any point to foci	add up to fixed constant	differ by fixed constant
Location of vertices	2 points which are farthest apart	2 points on 2 branches which are closest together
Equation regarding distance to foci	$PF_1+PF_2=$ constant (distance between vertices)	$\left\|PF_1-PF_2\right\|=$ constant (distance between vertices)
Axis through vertices	Major axis	Transverse axis
Axis perpendicular to axis through vertices	Minor axis	Conjugate axis
Location of foci	Along axis through vertices – foci lie between center and vertices (conic wraps around foci)	Along axis through vertices – vertices lie between center and foci (conic wraps around foci)
Equation for distance from center to focus $c^2=$	difference of numbers under x^2 and y^2 (bigger number minus smaller number)	sum of numbers under x^2 and y^2
Location of center	Midpoint of major axis (between vertices) Midpoint of minor axis Midpoint between foci Intersection of major & minor axes	Midpoint of tranverse axis (between vertices) Midpoint of conjugate axis Midpoint between foci Intersection of asymptotes, transverse & conjugate axes

The slopes of the asymptotes of a hyperbola are $\pm\sqrt{\frac{\text{coefficient under } y^2}{\text{coefficient under } x^2}}$. (Remember, slope = $\frac{\Delta y}{\Delta x}$.) Both asymptotes of a hyperbola pass through the center of the hyperbola.

(*) For the number under the other variable, use the formula for the foci, or the formula for the slopes of the asymptotes.