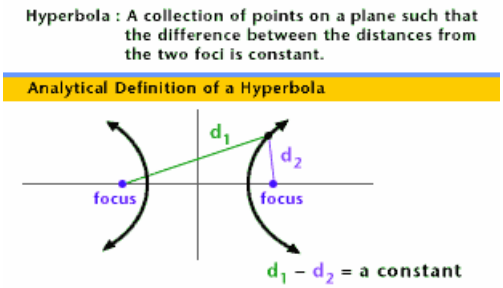
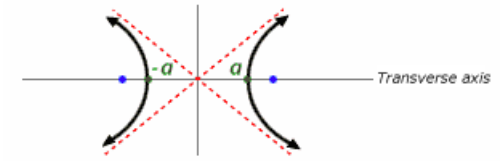
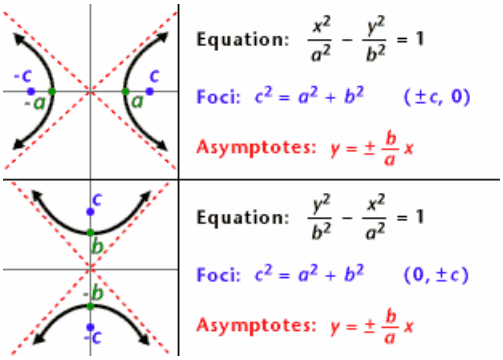
An Introduction to Hyperbolas

- A **hyperbola** consists of the set of points, the difference of whose distances from two fixed points is a constant. The two fixed points are called the **foci** of the hyperbola. The singular form of foci is focus.
- The standard equation for a hyperbola centered at the origin that opens to the left and right is $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ where the x-intercepts are at $\pm a$. The foci of the hyperbola are located at $(\pm c, 0)$, where $c^2 = a^2 + b^2$.
- The standard equation for a hyperbola centered at the origin that open up and down is $\frac{y^2}{b^2} - \frac{x^2}{a^2} = 1$ where the y-intercepts are at $\pm b$. The foci of the hyperbola are located at $(0, \pm c)$, where $c^2 = a^2 + b^2$.
- In either case, the hyperbola has asymptotes along the lines $y = \pm \frac{b}{a} x$.
- The **transverse axis** of a hyperbola passes through the foci.

	A hyperbola has a definition very similar to the definition of an ellipse. The major difference is that hyperbolas deal with a constant difference in the distances to two fixed points, rather than a constant sum.
	Hyperbolas reintroduce asymptotes, which you remember from earlier curves. The lines represent limits on the values used by the points in the hyperbolas since the curves approach the lines but never touch or intersect them. If a horizontal line can be drawn through the hyperbola's foci then the hyperbola has a horizontal transverse axis. If a vertical line can be drawn through the hyperbola's foci then the hyperbola has a vertical transverse axis.
	Here is a summary of the formulas for a hyperbola that opens to the left and right. Similar formulas exist for a hyperbola that opens upwards and downwards.