CONICS ARE COOL, MATH KNIGHTS RULE
Conics are the curves that are found when slicing a cone sitting nose-to-nose with another cone. The figure below shows the different kinds of conics.

Each conic has a unique equation and properties which will be explored in the following slides.
THE OVAL SHAPED ELLIPSE

\[
\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1
\]

(h,k) is the center

The larger denominator is the major axis, the smaller is the minor axis.

The major and minor axis’s are line segments going through the center.

The major axis is the larger of the two denominators, the smaller is the minor axis.

The a variable is the larger of the two. It is always placed under the major axis.
Snickerdoodles here is admiring this real life example of an oval shaped ellipse.

Looking at this ellipse, it is easy to see the major axis is going to be the y axis, since it is longer. Therefore the x axis is the minor.
The y axis is 53.5 cms.

The x axis is 44 cms
The center is (0,0)  
The major axis is y, so the standard equation would be in the following form:

\[
\frac{(x-h)^2}{b^2} + \frac{(y-k)^2}{a^2} = 1
\]

Vertices are ±(0, a)  
a is equal to the distance from the center to the top of the y axis ±(0, 26.75)

The endpoints of the minor axis are ±(b, 0)  
b is equal to the distance from the center to the end of the x axis ±(22, 0)

Plug in values to get equation

\[
\frac{x^2}{484} + \frac{y^2}{715.56} = 1
\]
The next example shows an ellipse with $x$ being the major axis.

The horizontal length of the leaf was 17 cm $a = 8.5$.

The height of the leaf was 7.5 cm $b = 3.75$.

Plug in $a$ and $b$ to the standard ellipse equation

$$\frac{x^2}{72.25} + \frac{y^2}{14.06} = 1$$
Being cool is tiring, this ellipse is resting in a bed frame.

Here the major axis is $y$.

The major axis has a length of exactly 12 in.

$a=6$

The minor axis has a length of exactly 8 in.

$b=4$

$$\frac{x^2}{16} + \frac{y^2}{36} = 1$$
A circle is a special type of ellipse when $a$ and $b$ are equal. The radius represents both $a$ and $b$.

There is no major or minor access since all points of a circle are the same distance away from the center.

Let's take a look at a real life example.
Records are circles that ROCK! For those in the younger generation, records are really big CD’s. To find an equation for this vinyl, measure the diameter with a ruler and divide by 2 to get the radius.
The ruler here shows the diameter to be 30 cm. That means the radius is 15 cms.

Both \( a \) and \( b \) will equal 15.
The center of the circle is (0,0). Therefore, $h=0$ and $k=0$.

$A=15 \quad B=15$

$15^2=225$

Plug into the equation:

$$\frac{x^2}{225} + \frac{y^2}{225} = 1$$

This can also be written as:

$$x^2 + y^2 = 225$$
THE PARABOLA

The parabola is U shaped.

If the parabola is horizontal:
\[(x - h)^2 = 4a(y - k)\]
If \(a\) is positive the parabola opens up, if negative it opens down

If the parabola is vertical:
\[(y - k)^2 = 4a(x - h)\]
If \(a\) is positive the parabola opens right, if negative it opens left.

The vertex of both types are \((h,k)\)
The famous golden arches of McDonald’s are a great representation of parabola’s in real life.

For this example, one of the two arches will be measured to set up an equation.
Measuring between the start of each arch at the bottom is it 4.4 cms. To get the x coordinate of the vertex divide 4.4/2=2.2 cms

Measure from 2.2 cms to the top of the arch to. This was 11.2 cm to get the y coordinates of the end points.
The vertex is (2.2,0)
h=2.2
k=0

It is a vertical parabola

\((x - 2.2)^2 = 4ay\)

To find a, plug in one of the points found (0,-11) is used here:

\[ 4a(-11)(0 - 2.2)^2 - 44a = 4.84 \]
\[ a = \frac{-44}{4.84} \]
\[ a = -\frac{44}{4.84} \]
\[ a = -0.11 \]

\((x - 2.2)^2 = -0.44(y)\)

The equation can be written like so:

\[ y = \frac{1}{-0.44}(x - 2.2)^2 \]
Parabolas have a real handle on things

It is a vertical parabola opening downward in this example.

The vertex is (0,3.5)

The parabola travels thru (-2,0) and (2,0). Either can be used to find the equation.

\[(x)^2 = 4a(y - 3.5)\]

Plug in point (2,0) and solve for a

\[4 = 4a(-3.5)\]
\[4 = -14a\]
\[a = -0.286\]

\[4(-0.286) = -1.144\]

\[(x)^2 = -1.144(y - 3.5)\]
The hyperbola consists of two shapes reflecting each other on the same graph.

Hyperbolas are strict conic shapes because they have various boundaries.

The equation in standard form of a hyperbola:

With x major axis
\[
\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1
\]

With y major axis
\[
\frac{(y-k)^2}{b^2} - \frac{(x-h)^2}{a^2} = 1
\]

The vertices and the foci are found just like an ellipse.

The asymptotes for a hyperbola are
\[
y = \pm \frac{b}{a} x
\]
Hyperbola of a Basketball

Conics not only rock and roll, they are playful as well.

This basketball will be an real life example showing how making a hyperbola equation can be “nothing but net”!
The horizontal length between the two vertices was 5.5 cm so $a = 2.75$.

The conjugate axis was 6.5 cm so $b = 3.25$.

Plug in $a$ and $b$ to get the equation

$$\frac{x^2}{7.56} - \frac{y^2}{10.56} = 1$$
Discovering and working with everyday conics has helped in the understanding of each equation type and their unique properties.

Whether looking into a mirror and seeing an ellipse, or playing basketball and bouncing a hyperbola, math is all around us.

So, next time Prince is jamming in the background, think “Conics are cool!”
Music sound clips
Prince "When Doves Cry."
Julie Andrews “I Feel Pretty.”