**Activity 1.2.4b Are Conics Functions?**

Conic sections are the circles, parabolas, ellipses, and hyperbolas that you studied in Geometry. In this activity we will explore the graphs of conic sections and determine whether each conic is *always* a function, *sometimes* a function, or *never* a function.

**Circles**: The standard form of the equation of a circle is $x^{2}+y^{2}=r^{2}$, where *r* is the radius of the circle.

1. Graph the circle .

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1. Is the circle a function? Explain.
2. Dilate the circle by a scale factor of 2 (that is, make the radius twice as big) and graph the circle.



1. Is the circle a function? Explain.

1. Is a circle *always* a function, *sometimes* a function, or *never* a function? Explain your answer.

**Ellipses**: The standard forms of the equation of an ellipse, centered at the origin, with foci on an axis *c* units from the origin, are  (major axis is horizontal), or  (major axis is vertical), where $c^{2}=a^{2}-b^{2}$.

1. Below are two ellipses. What are the similarities and differences between the two?



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1. Below are two ellipses in the form . What are the similarities and differences between the two? What is the effect of the value of h?

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1. Below are two ellipses in the form . What are the similarities and differences between the two? What is the effect of the value of *k*?

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1. Sketch a graph of what  would look like using the results of questions 7 and 8.

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1. Sketch a graph of what  would look like using the results of questions 7 and 8.

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1. Is an ellipse *always* a function, *sometimes* a function, or *never* a function? Explain your answer

**Parabolas**: The standard forms of the equation of a parabola are:

* $(x-h)^{2}=4p(y-k)$, where the vertex is (*h*, *k*), the axis of symmetry is parallel to the *y*-axis, the focus is (*h*, *k* + *p*), and the directrix is the line $y=k-p$, or
* $(y-k)^{2}=4p(x-h)$, where the vertex is (*h*, *k*), the axis of symmetry is parallel to the *x*-axis, the focus is (*h* + *p, k*), and the directrix is the line $x=h-p$.
1. Describe what happens when the parameters *h* and *k* change for the parabola in the form $(x-h)^{2}=4p(y-k)$.

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| $$x^{2}=4y$$ | $(x+3)^{2}=4(y-2)$ |
| $$(x-4)^{2}=4(y-1)$$ | $$(x+5)^{2}=4(y+4)$$ |

1. Describe what happens when the parameters *h* and *k* change for the parabola in the form $(y-k)^{2}=4p(x-h)$.

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| $$y^{2}=4x$$ | $$(y-2)^{2}=4(x+3)$$ |
| $$(y-1)^{2}=4(x-4)$$ | $$(y+4)^{2}=4(x+5)$$ |

1. Is a parabola *always* a function, *sometimes* a function, or *never* a function? Explain your answer.

**Hyperbolas**: The standard forms of the equation of a hyperbola centered at (*h*, *k*) with foci *c* units from the center are (opens to left and right), OR (opens up and down), where $c^{2}=a^{2}+b^{2}$.

1. Below are two hyperbolas in the form . What are the similarities and differences between the two?

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1. Below are two hyperbolas in the form . What are the similarities and differences between the two?

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1. Is a hyperbola *always* a function, *sometimes* a function, or *never* a function? Explain your answer.