Lesson Plan Template - EDTC 710
Title of Project: Exploring Families of Functions, Transformations, and Inverses
Lesson Plan Topic: Exploring Transformations of Functions

Teacher: Jillian Scheschuk	**Subject: Algebra 2 & Trigonometry**	**UNIT: Families of Functions, Transformations, and Inverses**
NJ SLS: NJ-SLS-Math F-IF B. 4-5: Interpret key features of graphs and tables according to various models, as well as sketch graphs given features or verbal descriptions of relationships. NJ-SLS-Math F-IF C. 7-9: Graph functions by hand or by using technology to be able to identify and compare key components such as intercepts, maxima, and minimum for parent functions.		

Essential Questions: What should students know, understand, and be able to do?	How can you analyze families of graphs? How do transformations affect parent functions? How can patterns, functions, and relations be used as tools to best describe and help explain real-life situations?
Enduring Understandings	All graphs are some distorted or changed version of their parent function Not all functions have the same domain and range A function is a specific type of a relation (one-to-one relationship) Function notation is a way to more efficiently communicate the relationship between x and y
Guiding Question(s)	How can knowing the graph of a parent function help to find the graph of a transformed function? How does the placement of different values in an equation affect the graph differently? Does ______________ **always** work? Why/why not?
Procedures (Teaching Strategies, Activities, Technology, Materials)	I will give an introduction to the activity and quick review of vocab. We will discuss the opening question on the handout (see attached) and make predictions. Students will work together and use their tablets to complete the exploration on Desmos. I will monitor discussions and lightly guide students along the way. We will recap at the end of class if time or else the following day.
Assessment	Class discussion
Homework	None (unless students need to finish the activity)

Objective: To discover and analyze transformations of functions. Date: _______________

Transformations of Parent Functions

*Recall: A parent function is the simplest form in a set of functions that form a family. Each function in the family is a **transformation** of the parent function.*

Example: Flipper the dolphin jumps up out of the water and then comes back down. Suppose at a given time in seconds (t), Flipper's height above the water (in feet), $h(t)$, is modeled by the function $h(t) = -\frac{1}{2}(t-4)^2 + 7$.

What is the parent function in this example?

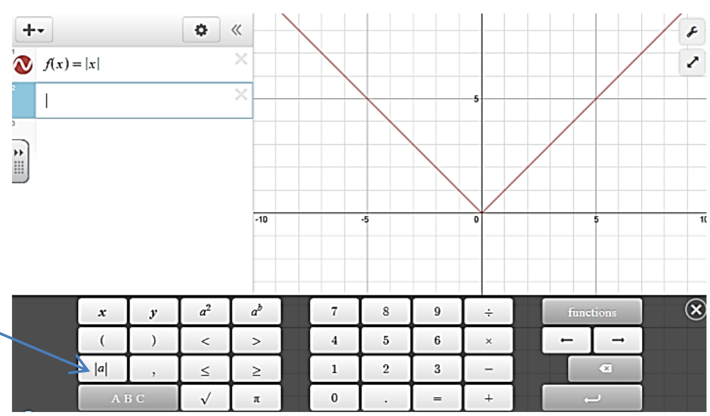
How is the given function different from the parent function?

How do Transformations affect Parent Functions?

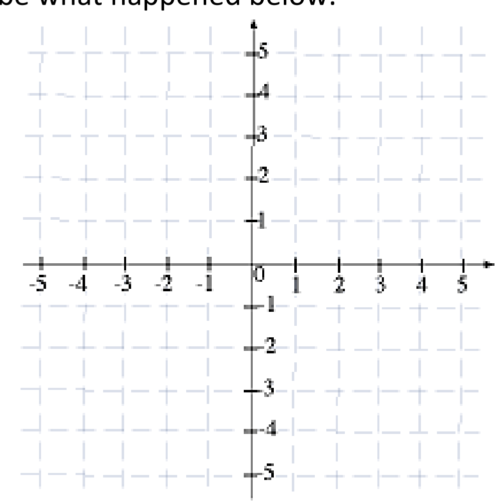
Go to desmos.com and click "Start Graphing."

1. Enter the following function: $f(x) = |x|$

Absolute Value

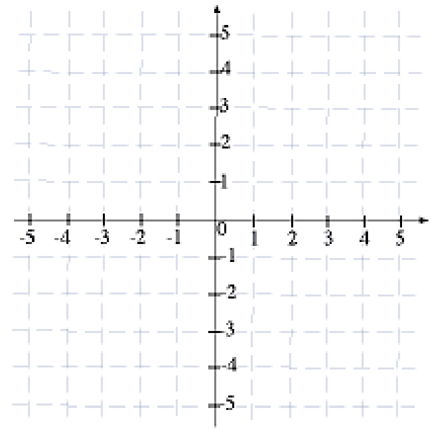


2. On the same grid, now graph the following function: $g(x) = |x| + 2$.
   What do you notice? Sketch and label the graphs and describe what happened below.



Next, leave on $f(x) = |x|$ but turn *off* the $g(x)$ function by deselecting the color circle to the left of the equation.

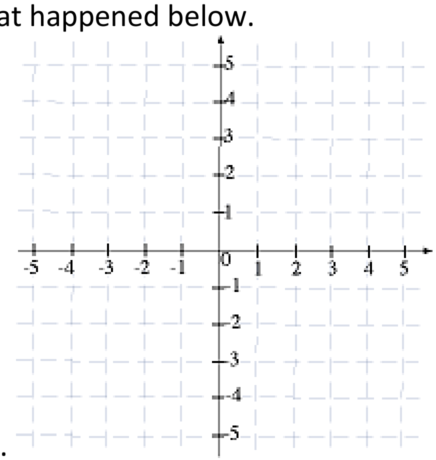
3. On the same grid as $f(x)$, graph the function $h(x) = |x| - 3$.
   What do you notice? Sketch and label the graph and describe what happened below.



Use your conclusions from #2 and #3 to write the equation of an **absolute value** function, $a(x)$, that is *translated 5 units up*. Check your answer using Desmos, then write a **quadratic** function, $q(x)$ that is also *translated 5 units up*.

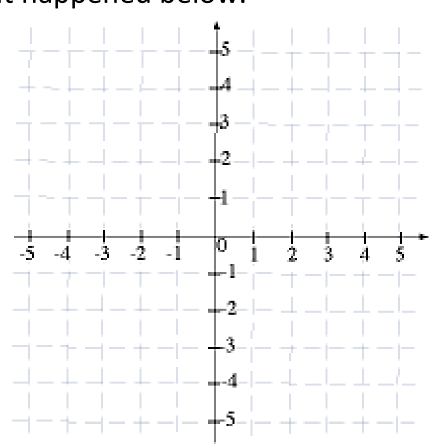
On Desmos, leave on the function $f(x) = |x|$, but shut off any other functions.

4. Now, on the same grid as $f(x)$, graph the function $i(x) = |x - 1|$
   What do you notice? Sketch and label the graph and describe what happened below.



Again, leave on the function $f(x) = |x|$, but shut off any other functions.

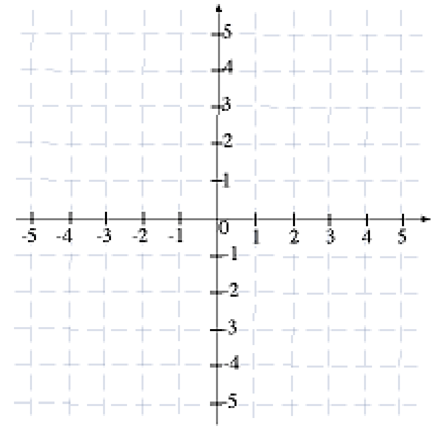
5. Now, on the same grid as $f(x)$, graph the function $j(x) = |x + 4|$
   What do you notice? Sketch and label the graph and describe what happened below.



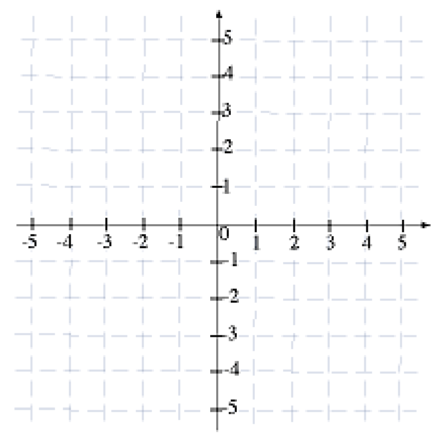
Use your conclusions from #4 and #5 to write the equation of an **absolute value** function, $b(x)$, that is *translated 7 units to the right*. Check your answer using Desmos, and then write a **cubic** function, $c(x)$ that is also *translated 7 units to the right*.

On Desmos, shut off the function $f(x) = |x|$ as well as any other functions.

6. Graph the function $k(x) = \sqrt{x}$. Sketch the graph below.

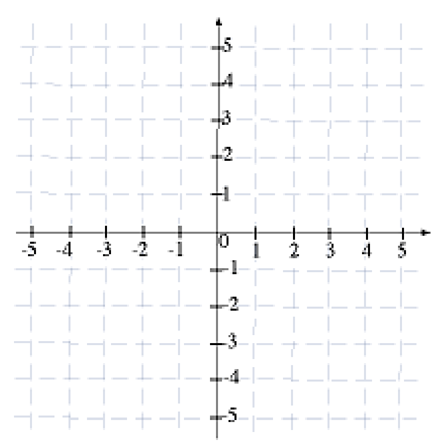


7. Now, on the same grid as $l(x)$, graph the function $l(x) = \sqrt{-x}$
   What do you notice? Sketch and label the graph and describe what happened below.



Leave on the function $k(x) = \sqrt{x}$, but shut off any other functions.

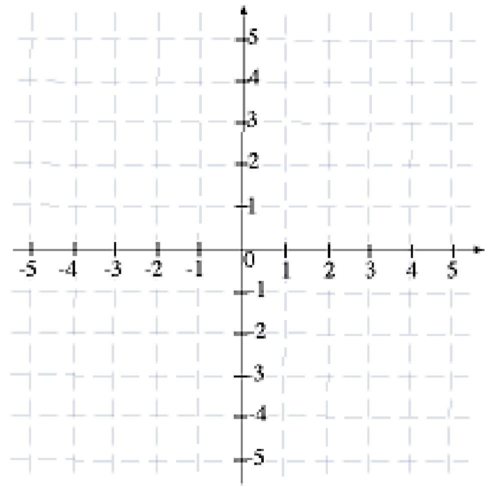
8. On the same grid, graph the function $m(x) = -\sqrt{x}$
   What do you notice? Sketch and label the graph and describe what happened below.



Use your conclusions from #7 and #8 to write the equation of an **absolute value** function, $d(x)$, that is *reflected over the x-axis*. Check your answer using Desmos, and then write an **absolute value** function, $e(x)$ that is *reflected over the y-axis*.

On Desmos, shut off the function $k(x) = \sqrt{x}$ as well as any other functions.

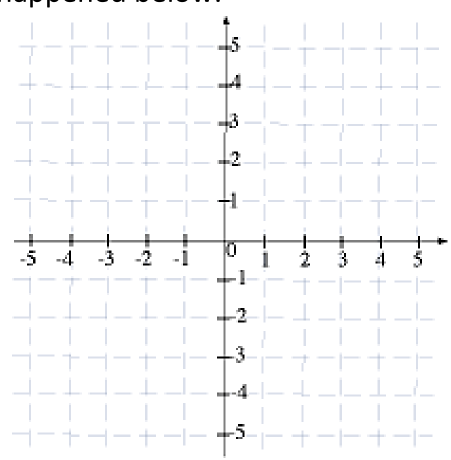
9. Graph the function $n(x) = \sin x$. Sketch the graph.



10. On the same grid, graph the function $p(x) = 3\sin x$.
    What do you notice? Sketch and label the graph and describe what happened below.

Leave on the function $n(x) = \sin x$, but shut off any other functions.

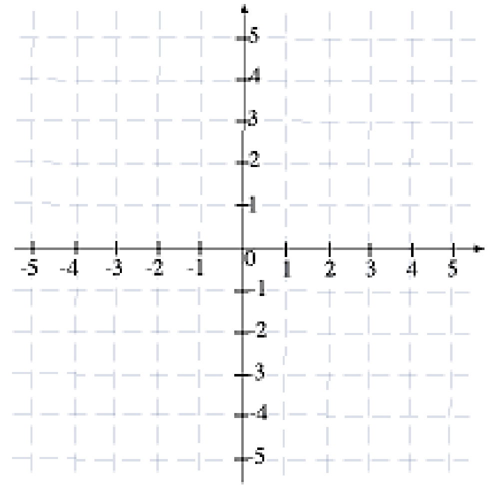
11. On the same grid, graph the function $p(x) = \frac{1}{2}\sin x$.
    What do you notice? Sketch and label the graph and describe what happened below.



Use your conclusions from #10 and #11 to write the equation of a **quadratic** function, $f(x)$, that is *stretched vertically* by the factor of your choice. Check your answer using Desmos.

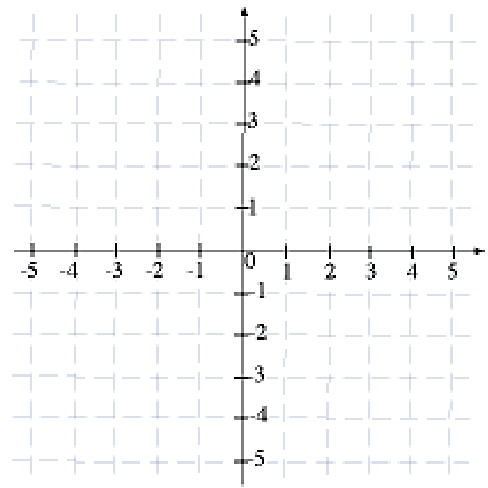
Leave on the function $n(x) = \sin x$, but shut off any other functions.

12. On the same grid, graph the function $r(x) = \sin\left(\frac{1}{2}x\right)$.
    What do you notice? Sketch and label the graph and describe what happened below.



Leave on the function $n(x) = \sin x$, but shut off any other functions.

13. On the same grid, graph the function $r(x) = \sin(2x)$.
    What do you notice? Sketch and label the graph and describe what happened below.



Use your conclusions from #12 and #13 to write the equation of a **quadratic** function, $g(x)$, that is *shrunk horizontally* by the factor of your choice. Check your answer using Desmos.

Flipper the dolphin jumps up out of the water and then comes back down. Suppose at a given time in seconds (t), Flipper's height above the water (in feet), $h(t)$, is modeled by the function:

$$h(t) = -\frac{1}{2}(t-4)^2 + 7.$$

a) How many transformations were performed on the function? Describe them.

b) Graph the function.

c) What is the maximum height the dolphin reached? After how much time did it reach that height?