Lesson Title: Transformations of Functions 4: All Transformations
Date:_____

Subject: Algebra I or Algebra II	T**opic:** Transformations of Functions
Grade: 9, 10, or 11	**Designer:** Jessica Ulcickas

Stage 1 – Desired Results

Lesson Overview: This activity teaches students about transformations of functions. There are three main types of transformations: translations, dilations, and reflections. Each type of transformation will affect the graph of a function in a different way. Translations move a graph up, down, left, or right. Dilations will stretch or compress the graph of a function. Reflections will flip the graph of a function from left to right, or top to bottom. In this activity, students will see how more than one transformation can change the graph of a function. By the end of this activity, students will be able to identify the transformations from an equation of a function and use those transformations to graph the function.

Standards Addressed:

CCSS.Math.Content.HSF-BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Enduring Understanding: Although there are many different types of functions, they all share similar properties. All functions respond in the same way when their equations are changed in specific ways. All functions can be affected by adding or subtracting from the function equation. This will move a function left, right, up, or down. All equations can also be affected by multiplying the equation by a constant, which will result in a stretch or compression. All functions will also be affected by negative signs which create reflections. When you	**Essential Questions**: How does the equation of a function affect its graphical representation? How does changing the equation of a function in more than one way affect its graphical representation? How can I use the equation of a function to graph the function without using ordered pairs?
Students will need to know: Students will need to have basic knowledge of functions and what their graphical representations are. This can be used at the	**Students will be able to**: • Identify a function reflection given an equation. • Identify a function translation given an

<table>
<tr><td>beginning of a unit on functions as a preview of coming attractions for function shapes, or towards the end of a year spent working with various functions in order to help students make connections.</td><td>equation.
• Identify a function dilation given an equation.
• Sketch a graph of a transformed function given the graph of the original function.</td></tr>
<tr><td colspan="2">Stage 2 – Assessment Evidence</td></tr>
<tr><td>Performance Tasks:
In this activity:

• Asking students to make predictions about how a specific change to the equation of a function will change the graph of the function.
• Asking students to graph a transformed function given a new equation.</td><td>Other Evidence:

• To be decided by the teacher.</td></tr>
<tr><td colspan="2">Stage 3 – Learning Plan</td></tr>
<tr><td>Lesson Procedure:

<u>Many Days Before</u>:

Students will be introduced to the topic of functions. Students should have general knowledge of parent functions (the most basic of functions) and the shape their graphs take on. At this point students should have knowledge of translations, dilations, and reflections of functions.

<u>Day Of</u>:
Students will go to the computer lab in order to complete this activity. For the duration of the activity, the teacher will monitor student progress to ensure that students complete the activity properly and do not simply click to complete. The activity will not take all class period, so the remainder of the class period will be at the discretion of the classroom</td><td>Required Materials:

• Computers for each student.</td></tr>
</table>

teacher.	
Possible Discussion Questions for Students: • Do you notice any patterns that could help you remember these rules? • Write your own function that has been translated, dilated, and reflected. • Look through your book. Are there any functions you have learned or will learn in the future that we haven't covered? Do you think these transformations will apply to those functions too?	**Sample Answers to Discussion Questions**: • Answers will vary. Sample answer: There are usually parentheses involved when something is horizontal. • Answers may vary. Sample answers: $f(x) = -2(x-3)^4$ • Sample answer: Yes they will apply. Trigonometric functions, logarithmic functions, absolute value functions, etc.