**Lesson Title: Transformations of Functions Part 1: Translations Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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| **Subject:** Algebra I or Algebra II T**opic:** Translations of Functions  **Grade:** 9, 10, or 11 **Designer:** Jessica Ulcickas | |
| **Stage 1 – Desired Results** | |
| **Lesson Overview**: This activity teaches students about translations of basic functions. A translation is a movement of the function left, right, up, or down. The function retains its basic shape, however by simply adding or subtracting values from the function or the x variable within the function, the graph will shift in one of four directions. By the end of the activity students will be able to identify a given function translation, identify the direction the graph will move, and graph a sketch of the translated function.  **Standards Addressed**:   * [CCSS.Math.Content.HSF-BF.B.3](http://www.corestandards.org/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 via the addition or subtraction of a constant. When a positive number is added to a function, the function will shift upward that many units. When a positive number is subtracted from a function, the function will shift downward that many units. When a positive number is subtracted from the x variable of a function, the function will shift right that many units. When a positive number is added to the x variable of a function, the function will shift left that many units. These translations apply to all functions, no matter the equation or shape. | **Essential Questions**:  How does the equation of a function affect its graphical representation?  How does adding or subtracting a constant from a function affect its graphical representation?  How does adding or subtracting a constant from the x variable of a function affect its graphical representation? |
| **Students will need to know**:  Students will need to have basic knowledge of functions and their graphical representations. This activity can be used at the 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. | **Students will be able to**:   * Identify a function translation given an equation. * Identify which direction a function will move, based on its equation. * Sketch a graph of a translated function given the graph of the original function. |
| **Stage 2 – Assessment Evidence** | |
| **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. | **Other Evidence**:   * To be decided by the teacher. |
| **Stage 3 – Learning Plan** | |
| **Lesson Procedure**:  Many Days Before:  Students will be introduced to the topic of functions. Students should have general knowledge of parent functions (the most basic functions) and the shapes of their graphs.  Day Of:  Students will need computers 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 teacher. | Required Materials:   * Computers for each student. |
| **Possible Discussion Questions for Students**:   * Do you notice any patterns that could help you remember these rules? * Do you have any predictions about what other transformations there are? * In what type of function would a horizontal translation and vertical translation be the same? | **Sample Answers to Discussion Questions**:   * Answers will vary. Sample answer: There is usually a set of parentheses in the equation when there is a movement left or right. * Answers may vary. Sample answer: What about flipping the function upside down? * A linear function. |